OPERATING AND SERVICE MANUAL

# GAIN-PHASE METER

## 3575A

HEWLETT PACKARD

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# OPERATING AND SERVICE MANUAL

# MODEL 3575A
# GAIN-PHASE METER

**Serial Number: 1450A01646**

**IMPORTANT NOTICE**

This loose-leaf manual does not require a change sheet. All change information has been integrated into the manual by means of revised pages. Each revised page is identified by a revision letter located at the bottom of the page. A reference, located directly below the revision letter, indicates which of the backdating changes in Appendix C apply to that page. If the serial number of your instrument is lower than the one on this title page, the manual contains revisions that may not apply to your instrument. Refer to Appendix C for complete backdating information.

**WARNING**

*To help minimize the possibility of electrical fire or shock hazards, do not expose this instrument to rain or excessive moisture.*

**Manual Part No. 03575-90002**

**Microfiche No. 03575-90053**

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## CERTIFICATION

*Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.*

## WARRANTY

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## SAFETY SUMMARY

**The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements. This is a Safety Class 1 instrument.**

### GROUND THE INSTRUMENT

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

### DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

### KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

### DO NOT SERVICE OR ADJUST ALONE

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

### DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

### DANGEROUS PROCEDURE WARNINGS

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

**WARNING**

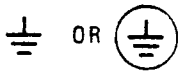
**Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.**

## SAFETY SYMBOLS

### General Definitions of Safety Symbols Used On Equipment or In Manuals.

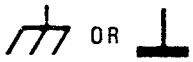
Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the instrument.

Indicates dangerous voltage (terminals fed from the interior by voltage exceeding 1000 volts must be so marked).




Protective conductor terminal. For protection against electrical shock in case of a fault. Used with field wiring terminals to indicate the terminal which must be connected to ground before operating equipment.

Low-noise or noiseless, clean ground (earth) terminal. Used for a signal common, as well as providing protection against electrical shock in case of a fault. A terminal marked with this symbol must be connected to ground in the manner described in the installation (operating) manual and before operating the equipment.




Frame or chassis terminal. A connection to the frame (chassis) of the equipment which normally includes all exposed metal structures.

Alternating current (power line).

Direct current (power line).

Alternating or direct current (power line).

**WARNING**

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

**CAUTION**

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, condition or the like, which,if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product.

NOTE:

The NOTE sign denotes important information. It calls attention to procedure, practice, condition or the like, which is essential to highlight.

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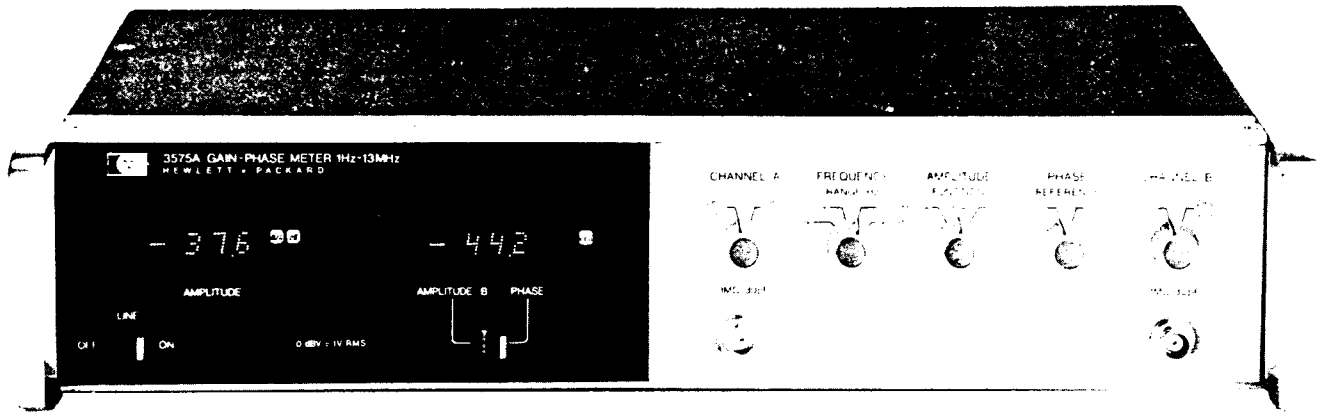


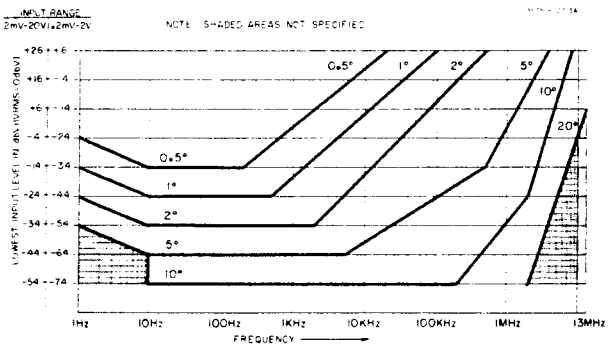

3575-A-2843

**Figure 1-1. Model 3575A Gain-Phase Meter.**

**Table 1-1. Specifications.**

## PERFORMANCE RATING

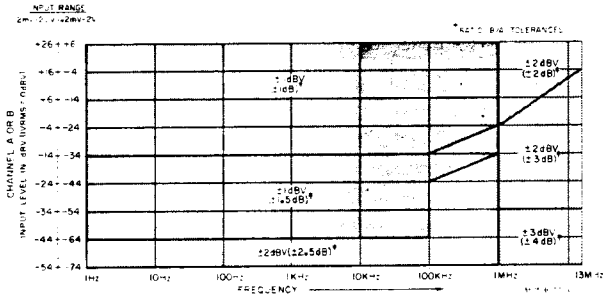
### Phase Accuracy (At Analog Output)*




*Conditions:

1) Temperature Range 15° to 35° C.
2) Lowest applicable Voltage Range settings must be used.
3) Lowest applicable Frequency Range setting must be used.
4) Analog Output Voltage = 10 mV per degree with > 2 Megohm load resistance.
5) Phase Stability and Accuracy is specified for a period of 90 days after calibration.

### Amplitude Accuracy (At Analog Output)**




**Conditions:

1) Temperature Range 15° to 35° C.
2) The accuracy of ratio (B/A) measurements is determined by the lowest input level and highest input frequency. If the two input signals are not of the same frequency, add ± 0.5 dB to existing ratio tolerances.
3) Analog Output Voltage = 10 mV per dB/dBV with > 2 Megohm load resistance.
4) Amplitude Stability and Accuracy is specified for a period of 90 days after calibration.

**Panel Meter Accuracy**: ± 3 counts (0.3 degrees, 0.3 dB/dBV)†

†Must be added to Amplitude Accuracy and Phase Accuracy specifications to obtain total error tolerances for panel meter readings.

**Input Shunt Capacitance**: < 30 pF (Also see Input Impedance listing in Table 1-2.)

# SECTION I
# GENERAL INFORMATION

## 1-1. DESCRIPTION.

1-2. The Hewlett-Packard Model 3575A Gain-Phase Meter is a versatile, wide-range ac voltage analyzer which affords direct, convenient measurement of amplitude and phase parameters. The major features of the instrument include broadband frequency response, wide dynamic range, digital readout plus a unique detection scheme which ensures accurate phase measurements in the presence of noise and distortion. These standard features, along with a variety of options including dual panel meters, BCD output and remote control, make the 3575A a truly flexible instrument that is well suited for bench or systems applications.

1-3. The broadband frequency response of the Model 3575A extends from 1 Hz to 13 MHz in four overlapping frequency ranges. For maximum operating convenience, each range is designed to cover a wide band of frequencies while range selectability allows the user to optimize measurement accuracy and settling time over the entire frequency spectrum.

1-4. The 3575A is equipped with two independent input channels. Each channel provides an 80 dB dynamic range which allows "hands off" operation with a wide range of input levels. In addition, each channel is equipped with a 20 dB input attenuator which provides an extended operating capability of 100 dB in two voltage ranges. Input sensitivity is from 0.2 mV rms to 2 V rms on the lower range and 2 mV rms to 20 V rms on the higher range. The 1 Megohm $<$ 30 pF input impedance of each channel permits the use of 10:1 divider probes which further extend the maximum input level to 200 V rms and the overall operating range to 120 dB.

1-5. The 3575A contains a built-in dc digital voltmeter which provides a direct indication of amplitude or phase on a 3 1/2 digit (LED) display. Lighted annunciators on the panel meter indicate dB V, dB or degrees depending on the parameter being measured. The panel meter display is determined by the front panel Display switch which permits selection of Amplitude or Phase presentation. For recording purposes, an Analog Output (BNC) connector is provided on the rear panel of the instrument. The Analog Output supplies a dc voltage proportional to the panel meter reading.

1-6. When Amplitude Display is selected, the panel meter presentation is controlled by the front panel Amplitude Function switch which permits selection of three different functions. These functions are Log A, Log B and Log B/A. When Log A or Log B is selected, the panel meter indicates the logarithmic amplitude of the respective input signal in dBV (1 V rms = 0 dBV). Input levels from 0.2 mV rms (- 74 dBV) to 20 V rms (+ 26 dBV) can be measured with 0.1 dBV resolution in two voltage ranges. When Log B/A is selected, the panel meter indicates the relative amplitude of the two input signals in dB. The display range for relative measurements is from - 100 dB to + 100 dB with 0.1 dB resolution. Since the two input channels each contain ac/dc converters and are totally independent, relative measurements can be made between two signals that differ in frequency.

1-7. The 3575A amplitude functions are particularly useful for measuring gain, attenuation and other characteristics where amplitude comparison is required. The Log B/A function eliminates the need for separate input and output measurements and time consuming difference calculations.

1-8. When Phase Display is selected, the 3575A measures the phase difference between two input signals. The phase measurement range is from - 180 degrees to + 180 degrees with 12 degrees overrange and 0.1 degree display resolution. Due to the wide dynamic range of the instrument, phase difference can be measured between two signals that differ in amplitude by as much as 100 dB.

1-9. An accurate phase meter is of little value unless the accuracy can be maintained in the presence of noise and distortion. Unlike conventional phase meters, the 3575A uses two phase detectors rather than a single phase detector. This, in conjunction with a highly effective error correction scheme, greatly reduces the effects of noise and distortion on phase readings.

## 1-10. SPECIFICATIONS.

1-11. Table 1-1 is a complete list of the Model 3575A critical specifications that are controlled by tolerances. Table 1-2 contains general information that describes the operating characteristics of the Model 3575A.

1-12. Any changes in specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards are included in Table 1-1 in this manual. Specifications listed in this manual supersede all previous specifications for the Model 3575A.

## 1-13. OPTIONS.

1-14. There are presently three instrument and two accessory options available for the Model 3575A. These options are as follows:

| Option | Factory Installed* |
|---|---|
| Dual Panel Meters | Option 001 |
| Dual Panel Meters, BCD Outputs and Remote Control | Option 002, Option 003** |
| Kit, Rack Mount | Option 908 |
| Additional Manual | Option 910 |

* Field installable option kits are available.

** Options 002 and 003 are identical except for assertion states of BCD outputs (see Table 1-2).

Table 1-2. General Information.

INPUTS

**Front Panel Inputs:** Female BNC connectors

Input Impedance: 1 Megohm (nominal) shunted by < 30 pF

**Rear Panel Inputs:** Holes are provided on the rear panel for installing BNC input connectors in place of the front panel input connectors. When rear-panel inputs are used, the shunt capacitance increases to approximately 40 pF (not compatible with 10:1 divider probes).

ANALOG OUTPUTS

**Connectors:** Female BNC connectors, labeled ANALOG OUTPUT 1 and ANALOG OUTPUT 2 are located on the rear panel of the instrument. Analog Output 2 is used only in instruments equipped with dual panel meters (Options 001 and 002).

**Resistance:** 1 Kilohm (nominal)

**Output Voltage:**

Amplitude Measurements: 10 mVdc per dB/dBV with > 2 Megohm load resistance.
Phase Measurements: 10 mVdc per degree with > 2 Megohm load resistance.

RESPONSE TIME

**Typical Settling Time:** (following a change in input parameters):

| Frequency Range | 100 % * Settled | 95 % * Settled | 90 % * Settled |
|---|---|---|---|
| 1 Hz - 1 kHz | 30 sec. | 20 sec. | 17 sec. |
| 10 Hz - 100 kHz | 3 sec. | 2 sec. | 1.7 sec. |
| 100 Hz - 1 MHz | 0.3 sec. | 0.2 sec. | 0.17 sec. |
| 1 kHz - 13 MHz | 30 ms. | 20 ms. | 17 ms. |

* Percent of final reading

RANGES

**Frequency Range:** 1 Hz to 13 MHz in four ranges:

1 Hz to 1 kHz
10 Hz to 100 kHz
100 Hz to 1 MHz
1 kHz to 13 MHz

**Dynamic Range:** 80 dB

**Operating Range (Each Channel):** 100 dB in two ranges:

0.2 mV rms to 2 V rms (- 74 dBV to + 6 dBV)
2 mV rms to 20 V rms (-54 dBV to + 26 dBV)

DISPLAY MODES

Amplitude or Phase (front panel DISPLAY switch)

AMPLITUDE MEASUREMENTS

**Amplitude Functions:** A dBV, B dBV, or B/A (front panel AMPLITUDE FUNCTION switch)

**Display Range (A dBV, B dBV):** - 74.0 dBV to + 26.0 dBV (in two Voltage Ranges)

**Display Range (B/A):** - 100.0 dB to + 100.0 dB*

* Both input signals must be within the range of 0.2 mV rms to 20 V rms.

**Display Resolution:** 0.1 dBV, 0.1 dB

**Amplitude Reference (A dBV, B dBV):** 1 V rms = 0 dBV

**Reference Channel (B/A):** Channel A*

* A negative reading means that the signal applied to Channel B is lower in amplitude than the signal applied to channel A; a positive reading means that the signal applied to Channel B is greater in amplitude than the signal applied to Channel A.

PHASE MEASUREMENTS

**Phase Measurement Range:** - 180 degrees to + 180 degrees with 12 degrees overrange

**Display Resolution:** 0.1 degree

**Phase Reference:** A or - A (front PHASE REFERENCE switch)*

*1) Channel A is the reference channel. A negative reading means that B lags A; a positive reading means that B leads A.

*2) With the Phase Reference set to - A, Channel A is inverted and the phase reading is offset by 180 degrees.

**Error Introduced by Noise:** < 2 degrees (nominal) for a 1 V rms 10 kHz sine wave and 1 MHz gaussian noise on one channel with 30 dB signal to noise ratio using the 100 Hz to 1 MHz Frequency Range.

**Error Introduced by Distortion:**

Even Harmonics: Cancelled - No Error
Odd, In-Phase Harmonics: No Error
Odd, Out-of-Phase Harmonics: < 0.6 degrees (nominal) when total odd harmonic distortion is more than 40 dB below the fundamental.

Table 1-2. General Information (Cont'd).

## DIGITAL READOUT

**Display:** 3 1/2 digits with fixed decimal indicator, polarity sign and annunciators.

**Reading Rate (Internal Sampling):** 4 readings per second

## GENERAL

**Operating Temperature Range:** 0° C to + 55° C, unless otherwise specified

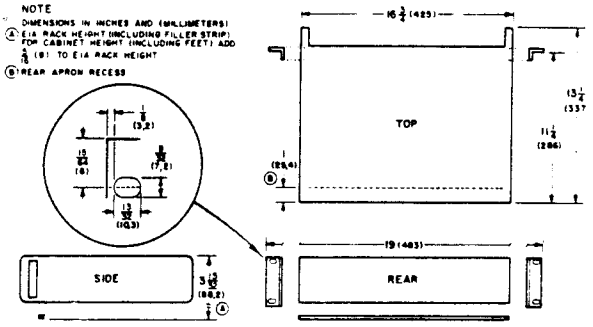
**Storage Temperature:** - 40° C to + 75° C

**Power Requirements:** 115 V or 230 V ± 10 %, 48 Hz to 440 Hz, 50 VA, maximum.

**Weight:**

Net Weight: 18 1/4 lbs.
Shipping Weight: 25 lbs.

**Dimensions:**




## OPTIONS

**Dual Panel Meters (Option 001):** The 3575A Option 001 is equipped with dual panel meters and dual analog outputs for simultaneous amplitude and phase presentations.

Left-Hand Panel Meter: Indicates A dBV, B dBV or B/A as determined by the Amplitude Function switch setting.

Right-Hand Panel Meter: Indicates B dBV or phase as determined by the Amplitude B/Phase switch setting.

Dual Analog Outputs: Rear panel BNC connectors provide dc output voltages that correspond with the respective panel meter readings (also see Analog Output heading).

**Dual Panel Meters, BCD Output and Remote Control (Options 002, 003):** The 3575A Options 002, and 003 are equipped with dual panel meters and dual analog outputs (same as Option 001) plus dual BCD outputs and a complete remote control capability.

Remote Logic: The 3575A Option 002 uses Low True TTL logic for BCD outputs and remote control lines. The 3575A Option 003 uses High True TTL logic for BCD Outputs and Low True TTL logic for remote control lines.

| State | BCD Outputs * | Remote Control Lines |
|---|---|---|
| "0" | + 2.4 V to + 5 V | Open or + 2.4 V to + 5 V |
| "1" | 0 V to + 0.4 V | Gnd. or - 0.5 V to + 0.4 V |

* In 3575A Option 003, BCD Outputs are High True.

BCD Outputs: Provide parallel binary-coded data that corresponds with the respective panel meter reading. Fourteen lines for each panel meter include three 8-4-2-1 BCD-coded digits, a single line overrange ("1") digit and a single line polarity indicator.

Overload Outputs: Three output lines, $A_{OL}$, $B_{OL}$ and "overload", indicate overload on A, overload on B and overload on A OR B.

Remote Control Lines: Eight input lines accept parallel binary instructions for remote control of all front panel functions, ranges and settings (except LINE ON/OFF). Internal storage is not provided.

Control Modes: Local or Remote (1 control line)

Remote Measure: 1 control line*

* In the Remote Control mode, the panel meters must be externally triggered by applying a ground-true momentary pulse (> 1 ms) to the Remote Measure line each time a reading is required. The Remote Measure command should not be applied for at least 0.5 ms following any change that affects the programmed state of the instrument.

Isolation: Remote input and output lines are *not* isolated.

Trigger Mode: Delayed or Non-Delayed (1 control line)*

* The trigger mode determines the time required to obtain panel meter readings or BCD outputs initiated by the Remote Measure command. In the Delayed mode the time is variable and is controlled by the Frequency Range setting:

| Frequency Range | Delay Time (nominal) |
|---|---|
| 1 Hz to 1 kHz | 33 seconds |
| 10 Hz to 100 kHz | 4 seconds |
| 100 Hz to 1 MHz | 1.1 seconds |
| 1 kHz to 13 MHz | 0.66 seconds |

In the Non-Delayed mode, the measurement time is fixed at 600 ms regardless of the Frequency Range setting.

Data Flags: + Data Flag and - Data Flag (2 output lines)*

* Provide a "Data Ready" indication to the external controller. Flags are "set" by the Remote Measure pulse and "reset" at the end of the delay (Trigger Mode) cycle.

| Condition | Indication | + Data Flag | - Data Flag |
|---|---|---|---|
| "Set" | Data Not Ready | 1 | 0 |
| "Reset" | Data Ready | 0 | 1 |

1-15. For further information concerning these options, refer to Table 1-2 (General Information) or Section III in this manual or contact the nearest -hp- Sales and Service Office.

## 1-16. ACCESSORIES SUPPLIED.

1-17. Table 1-3 is a list of accessories supplied with the Model 3575A.

## 1-18. ACCESSORIES AVAILABLE.

1-19. Table 1-4 is a list of Hewlett-Packard accessories that are available for use with the Model 3575A.

## 1-20. INSTRUMENT AND MANUAL IDENTIFICATION.

1-21. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within the series. If a letter is included with the serial number, it identifies the country in which the instrument was manufactured. If the serial number of your instrument is lower than the one on the title page of this manual, refer to Appendix C for backdating information that will adapt this manual to your instrument. All correspondence with Hewlett-Packard should include the complete serial number.

**Table 1-3. Accessories Supplied.**

| Description | Quantity | -hp- Part No. |
|---|---|---|
| Interface Connector (Opt. 002, 003) | 1 ea. | 1251-0086 |
| Accessory Kit | 1 ea. | 03575-84411 |
| Includes the following: | | |
| PC Board Extender (22 pin) | 1 ea. | 5060-5989 |
| PC Board Extender (12 pin) | 1 ea. | 5060-5988 |
| PC Board Extender (10 pin) | 1 ea. | 5060-5987 |

**Table 1-4. Accessories Available.**

| -hp- Model | Description |
|---|---|
| 10004A | Voltage Divider Probe (miniature) |
| 456A | AC Current Probe |
| 562A-16C | Printer Cable (for 5050A and 5055B Printers) |
| 11048C | 50 Ohm Feed-Thru Termination |
| 11094B | 75 Ohm Feed-Thru Termination |
| 11095A | 600 Ohm Feed-Thru Termination |
| 5060-8739 | Rack Mounting Kit |

# SECTION II

# INSTALLATION AND INTERFACING

## 2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing, shipping and interfacing the Model 3575A Gain-Phase Meter. Included are initial inspection procedures, power and grounding requirements, environmental information, mounting instructions, instructions for repackaging for shipment and interfacing information for Option 002 and 003 instruments.

## 2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (Table 1-3) and test the electrical performance of the instrument using the performance check procedures outlined in Section V. If there is damage or deficiency, see the warranty on the inside title page of this manual.

## 2-5. POWER REQUIREMENTS.

2-6. The Model 3575A can be operated from any source of 115 or 230 volts (± 10 %), 48 Hz to 440 Hz. Power dissipation is 50 VA; maximum.

### 2-7. Power Cords.

2-8. Figure 2-1 illustrates the standard power plug configurations that are used throughout the United States and in other countries. The -hp- part number shown directly below each plug drawing is the part number for a 3575A power cord equipped with the proper plug. If the appropriate power cord is not included with the instrument, notify the nearest Hewlett-Packard office and a replacement cord will be provided.

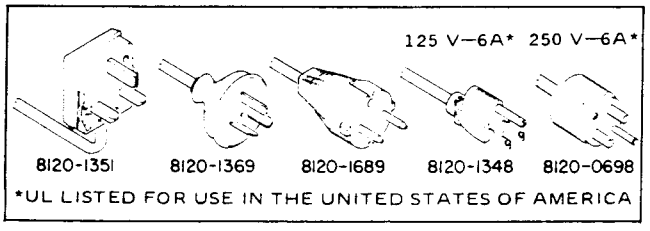



**Figure 2-1. Power Cords.**

## 2-9. GROUNDING REQUIREMENTS.

2-10. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. The Model 3575A is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power plug is the ground connection.

## 2-11. ENVIRONMENTAL REQUIREMENTS.

2-12. The Model 3575A is a low power, fully transistorized instrument; therefore, no special cooling arrangements are required. The 3575A should not be operated where the ambient temperature is below 0°C (32°F) or above 55°C (131° F) or where the relative humidity exceeds 95%. The instrument should not be stored where the ambient temperature is below -40°C (-40° F) or above 75°C (167°F).

## 2-13. INSTALLATION.

### 2-14. Bench Mounting.

2-15. The Model 3575A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument. The plastic feet are shaped so that the 3575A can be mounted on top of another Hewlett-Packard instrument.

### 2-16. Rack Mounting.

2-17. The Model 3575A can be rack mounted using the Rack Mounting Kit (-hp- 5060-8739) separately available as an accessory. Installation instructions are included with the kit. The rack mount for the Model 3575A is an EIA standard width of 19 inches.

## 2-18. REPACKAGING FOR SHIPMENT.

2-19. The following paragraphs contain a general guide for repackaging the instrument for shipment. Refer to Paragraph 2-20 if the original container is to be used; 2-21 if it is not. If you have any questions, contact the nearest -hp- Sales and Service Office (See Appendix B for office locations).

*NOTE*

*If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished. Include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number and full serial number.*

2-20. Place instrument in original container with appropriate packing material and seal well with strong tape or metal bands. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

2-21. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper, or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container "DELICATE INSTRUMENT", FRAGILE", etc.

## 2-22. INTERFACING (Options 002, 003 only).

*NOTE*

*The 3575A Options 002 and 003 are identical except that Option 003 instruments use high-true logic for the BCD outputs. In all other respects, the following information for Option 002 instruments also applies to Option 003 instruments.*

2-23. The 3575A Option 002 supplies BCD outputs that correspond with the panel meter readings and is equipped for remote control of all front panel functions, ranges and settings (except LINE ON/OFF). The remote input and output lines are available at the rear panel Interface connector, A19J1.

2-24. Figure 3-9 (Section III) illustrates the 3575A Option 002 Interface connector as viewed from the rear of the instrument. The connector drawing and the table within the figure provides complete input/output and control information. A 50-pin mating connector (-hp- 1251-0086*) and a 46-conductor cable are required to connect all input and output lines, circuit ground and +5 Vdc to an external controller or I/O card.

## 2-25. Computer Interfacing.

2-26. For interfacing the Model 3575A Option 002 to an -hp- computer, it will be necessary to utilize the information in this manual to develop I/O circuitry and software that meets individual system requirements. For more detailed information concerning the 3575A Option 002, refer to Paragraph 3-71.

## 2-27. Printer Interfacing.**

2-28. The 3575A Option 002 can be connected directly to an -hp- printer (Model 5050B or 5055A) using the -hp- 562A-16C printer cable. The 3575A BCD output and data flag connections are compatible with the 562A-16C cable and modifications to the printer or printer cable are not required. The printer, however, must be set or wired to accept ground-true BCD inputs and an external ground lead must be connected between the printer chassis and the 3575A chassis. In addition, there are two minor modifications that should be performed on the 3575A:

a. The Local/Remote control line (J1 pin 50) is automatically grounded when the 562A-16C printer cable is connected. Grounding the Local/Remote line enables the timing circuits in the 3575A but also disables the front panel controls and enables the remote control lines. Besides being inaccessible with the printer cable connected, the remote control lines (J1 pins 9 through 12, 34 through 37) are connected to the BCD input lines that control unused printer columns, 5 and 6. If remote control operation is desired, it will be necessary to fabricate an adapter that will isolate the unused printer-input lines and permit external connections to the 3575A control lines. If front panel operation is desired, connect the jumper wire on the 3575A Interface Assembly (A16B) between points 1 and 3 (see Paragraph 3-86).

b. When using a printer it is necessary to supply a Remote Measure command to the 3575A to initiate the measurement cycle. When the printer cable is connected to the 3575A, the Remote Measure line (J1 pin 21) is not accessible. For this reason, a test point labeled "TRIGGER" is provided on the Interface Assembly, A16B. The "trigger" test point is connected directly to the Remote Measure line. For convenience, install a female BNC connector (-hp- 1250-0083) in one of the holes provided on the rear panel (Item 13, Figure 3-2) and connect a short piece of wire between the BNC connector and the "trigger" test point on A16B. Apply the Remote Measure command to the BNC connector.(Also see Paragraph 3-80)

*NOTE*

*The 562A-16C printer cable does not provide a solid ground connection between the printer and the 3575A. For this reason, it is necessary to connect an external ground lead (short piece of copper braid) between the printer chassis and the 3575A chassis.*

2-29. For further information concerning the use of a printer with the 3575A Option 002, refer to Paragraph 3-87.

* Cinch No. 57-30500-375

** For Option 003 instruments, the printer must be set or wired to accept high-true BCD inputs.

# SECTION III
# OPERATING INSTRUCTIONS

## 3-1. INTRODUCTION.

3-2. This section contains complete operating instructions for the Model 3575A Gain-Phase Meter. Included is a description of controls, general operating information, a basic operating procedure and information concerning Option 001 through 003 instruments.

## 3-3. CONTROLS AND INDICATORS.

3-4. Figures 3-1 and 3-2 illustrate and describe the function of all front and rear panel controls, connectors and indicators. The description of each item is keyed to the drawing within the figure.

## 3-5. GENERAL OPERATING INFORMATION.

### 3-6. Input Connections.

3-7. The input signals can be applied to the 3575A through twisted pairs, shielded cables equipped with BNC connectors (-hp- 10503A Cable Assembly), or 10:1 divider probes (-hp- 10004A Voltage Divider Probe). Test leads should be kept as short as possible to minimize extraneous pickup and/or loss due to cable capacitance. When using 10:1 divider probes, it is first necessary to compensate the probes as outlined in Paragraph 3-62.

### 3-8. Grounding and Termination.

3-9. In the design of the 3575A, extra care has been taken to control internal ground currents that could degrade the accuracy of amplitude and phase readings. Due to it's wide dynamic range and high sensitivity, however, the 3575A can be affected by external ground currents or "ground loops" that are caused by poor grounding or incorrect termination. This means that when using the 3575A, particularly at low levels and low frequencies, the operator must be extremely "ground conscious" if accurate, repeatable readings are to be obtained.

3-10. There are basically two types of ground loops that can cause measurement errors in the 3575A. The first type, commonly known as a power-line ground loop, is encountered at frequencies below the power-line frequency or at integral multiples of the power-line frequency where either or both input signals are below 50 mV. The power-line ground loop is caused by extraneous currents that circulate between the signal source and the 3575A by way of power-line ground. The other type of ground loop is introduced by the signal source and is generally encountered at frequencies below 1 MHz where the signal applied to one channel is greater than 1 V rms and the signal applied to the other channel is less than 10 mV rms. These two types of ground loops are illustrated in Figures 3-3 and 3-4 and are discussed in the following paragraphs.

**3-11. Power-Line Ground Loop.** Figure 3-3A shows the input arrangement for a simple grounded measurement. Ein represents the source being measured along with any noise associated with it and is generally called the "normal-mode source". Rs represents the source resistance and the resistance of the high lead; Rg represents the resistance of the ground lead. Current from Ein (normal-mode current) flows through Rs, $Z_I$ and Rg and the instrument responds to the drop across $Z_I$. As long as the grounds on both sides of Rg are identical, extraneous currents cannot circulate between the source ground and the instrument ground. If, however, the grounds are different due to voltage drops in the ground lead or currents induced into it, a new source is developed and the measurement appears as shown in Figure 3-3B. The new source, Ecm (the difference between grounds) is called the "common-mode source" because it is common to both the high and ground lines. Common-mode current can flow through Rg or through Rs and $Z_I$. Since $Z_I$ is usually much larger than Rs and since they are both in parallel with Rg, most of the voltage across Rg will appear across $Z_I$ causing an error in the amplitude or phase reading.

3-12. To minimize power-line ground loops, the following guidelines should be observed:

a. Keep input leads as short as possible.

b. Provide good ground connections to minimize the resistance of Rg.

c. Connect the signal source and the 3575A to the same power bus.

d. If a removable ground strap is provided on the signal source, float the source to break the common-mode current path.

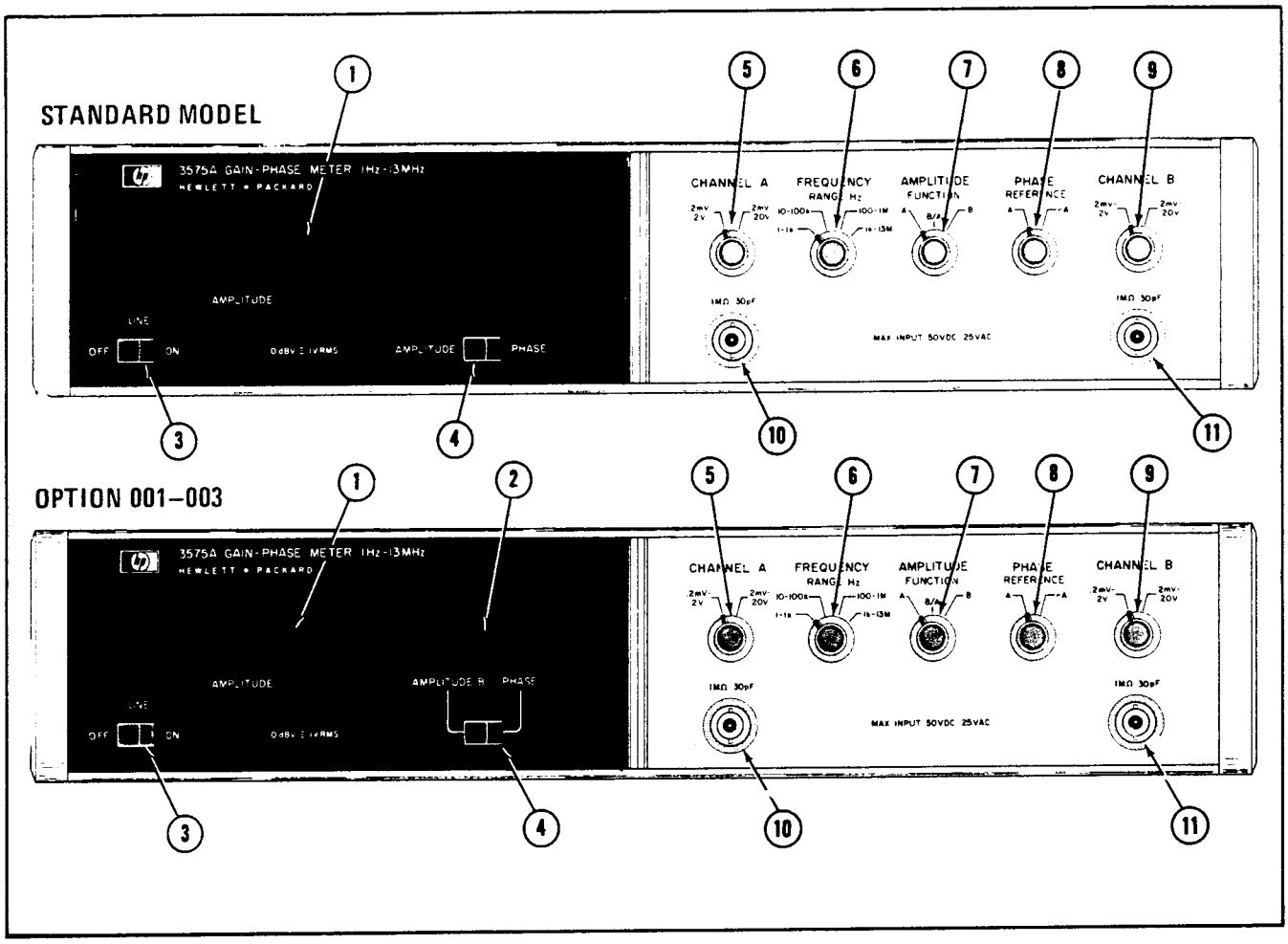



**Figure 3-1. Front Panel Description.**

(1) Panel Meter (Standard Model 3575A): Indicates amplitude or phase depending on position of DISPLAY switch (See Paragraphs 3-30 through 3-33).

(1) Left-Hand Panel Meter (Options 001–003): Indicates amplitude only and is controlled by the AMPLITUDE FUNCTION switch (See Paragraphs 3-32, 3-65 through 3-68).

(2) Right-Hand Panel Meter (Options 001–003 only): Indicates B dBV or phase depending on position of AMPLITUDE B/PHASE switch (See Paragraphs 3-33, 3-68 and 3-69).

(3) LINE Switch: Applies line voltage to the instrument when set to the ON position.

(4) DISPLAY Switch (Standard Model 3575A): Selects AMPLITUDE or PHASE presentation.

(4) AMPLITUDE B/PHASE Switch (Options 001–003: Selects AMPLITUDE B (B dBV) or PHASE presentation for the Right-Hand Panel Meter.

(5) Channel A Voltage Range Switch: Selects the input range for channel A (See Paragraphs 3-24 through 3-26).

(6) FREQUENCY RANGE Switch: Selects any of four overlapping frequency ranges. The upper limit within each range applies to phase only. The lower limit applies to both amplitude and phase (See Para 3-27 through 3-29).

(7) AMPLITUDE FUNCTION Switch (Standard Model 3575A): Controls the meter presentation when the DISPLAY switch is in the AMPLITUDE position. The AMPLITUDE FUNCTION switch selects any of three functions: Log A (A dBV), Log B (B dBV) or Log B/A (dB).

(7) AMPLITUDE FUNCTION Switch (Options 001–003): Controls the Left-Hand Panel Meter presentation. As in the Standard Model 3575A, selects Log A (A dBV), Log B (B dBV) or Log B/A (dB).

(8) PHASE REFERENCE Switch: Controls the phase of the reference channel, Channel A. With the PHASE REFERENCE switch set to the A position, the phase reading is direct. With the switch set to the - A position, the channel A signal is inverted and the phase reading is offset by 180 degrees (See Paragraphs 3-34 through 3-36).

(9) Channel B Voltage Range Switch: Selects the input range for channel B (See Paragraphs 3-24 through 3-26).

(10) Channel A Input Connector: Female BNC connector accepts 0.2 mV rms to 20 V rms, 1 Hz to 13 MHz input signal for channel A. Input impedance is 1 Megohm (nominal) 30 pF (See Paragraphs 3-6 and 3-7).

(11) Channel B Input Connector: Female BNC connector accepts 0.2 mV rms to 20 V rms, 1 Hz to 13 MHz input signal for channel B. Input impedance is 1 Megohm (nominal) 30 pF (See Paragraphs 3-6 and 3-7).

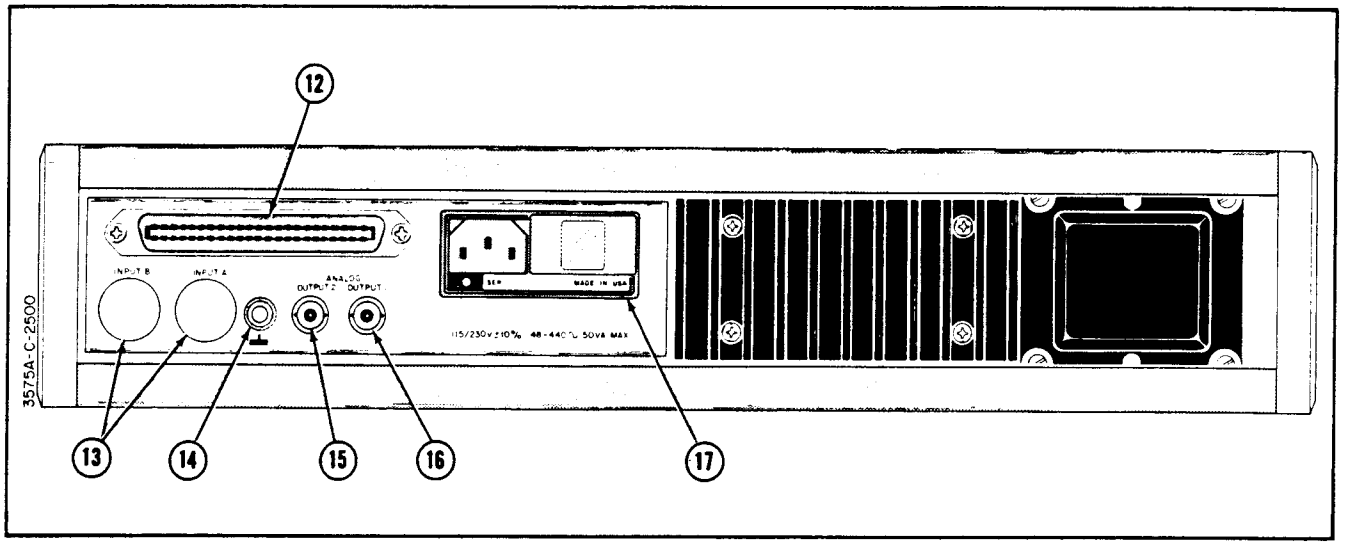



**Figure 3-2. Rear Panel Description.**

(12) Interface Connector, A19J1 (Options 002, 003 only): Accepts low-true binary inputs for remote control of all front panel functions, ranges and settings. Supplies 8-4-2-1 BCD-coded outputs for the two panel meters (See Paragraphs 3-71 through 3-74).

(13) Holes: Provided for installing rear panel input connectors in place of the front panel connectors.

(14) Ground Terminal: Connected to circuit ground and outer chassis ground. Terminal permits connection to chassis of signal source or to other external ground to help minimize ground loops (See Paragraph 3-17).

(15) ANALOG OUTPUT 2 (Options 001–003 only): Supplies dc voltage (10 mV/dBV or 10 mV/deg.) that corresponds with the Right-Hand Panel Meter reading (See Paragraphs 3-37 through 3-40).

(16) ANALOG OUTPUT 1 (Standard Model 3575A): Supplies dc voltage (10 mV/dB or 10 mV/degree) that corresponds with the panel meter reading. (See Paragraphs 3-37 and 3-38).

(16) ANALOG OUTPUT 1 (Options 001–003): Supplies dc voltage (10 mV/dB) that corresponds with Left-Hand Panel Meter reading (See Paragraphs 3-37 through 3-40).

(17) Power Input Module (A18): Accepts power cord supplied with the instrument. Contains line fuse and 115 V/230 V selector switch (See Figure 3-5).

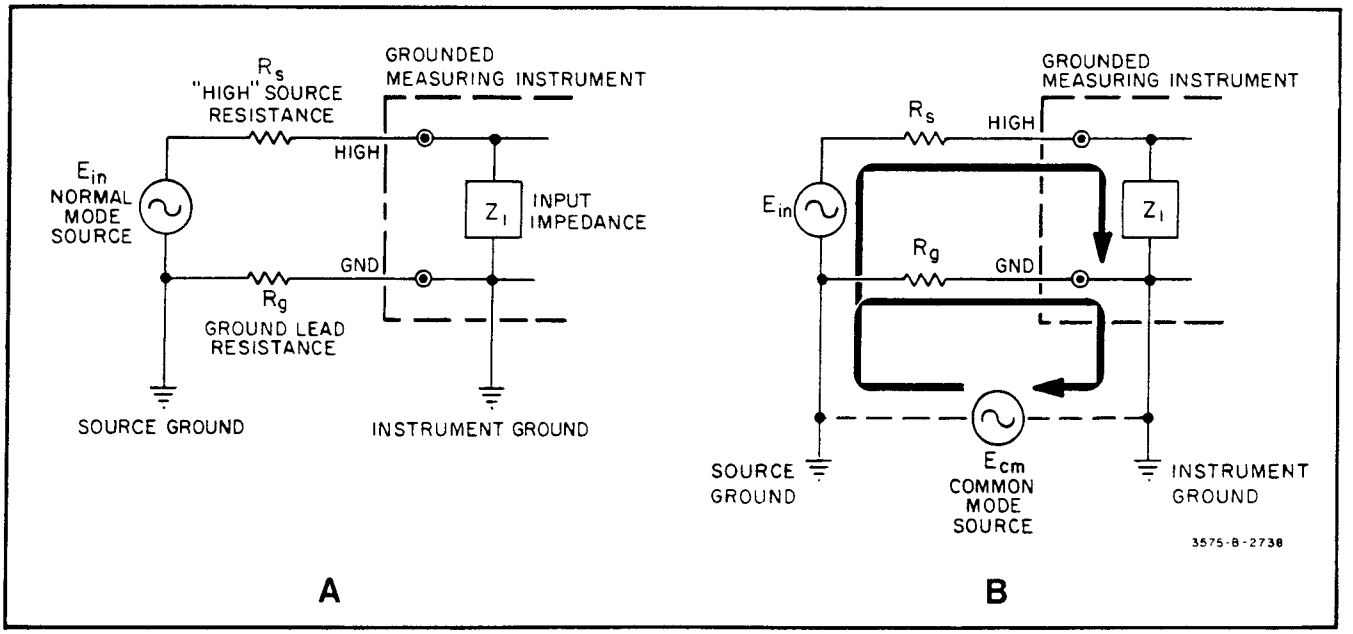



**Figure 3-3. Power-Line Ground Loop.**

**3-13. Source-induced Ground Loop.** Figure 3-4 illustrates a ground loop that is introduced by the signal source. In Figure 3-4, the signal applied to channel A is 2 V rms and the signal applied to channel B is 0.2 mV rms. As illustrated in the figure, part of the current from the 2 V source returns through the ground lead of the 0.2 mV source producing a voltage drop across the ground lead resistance, Rg. As in the power-line ground loop, the source resistance, Rs and the ground lead resistance Rg are in parallel with Zb. Due to the 50 ohm termination place directly across Zb, however, less than half of the voltage dropped across Rg is present across Zb. Although this voltage is very small, it is large enough to affect the amplitude and/or phase of the 0.2 mV signal.

3-14. Note that most of the current from the 2 V source is flowing through the 50 ohm termination of the channel A input and depending on the resistance between the A and B input commons, a good portion of the current is returning through the channel B ground lead. If the 50 ohm termination was placed directly across the output of the 2 V source, however, very little current would flow in the ground leads. Lowering the current in the ground leads reduces the drop across $R_g$ and thereby minimizes the common-mode voltage and the resulting error.

3-15. Fortunately, this type of ground loop is predominate at low frequencies (below 1 MHz) where it is possible to terminate at the signal source rather than at the input of the measuring instrument. At high frequencies where it is necessary to terminate at the end of the transmission line, the error is normally insignificant as long as shielded cables or twisted pairs are used for the input connections.

3-16. To minimize ground currents introduced by the signal source, observe the following quidelines:

a. At frequencies below 1 MHz, place the termination for the high-level signal directly across the output of the high-level signal source.

1) At frequencies above 1 MHz, terminate at the 3575A input.

b. If termination for the low-level signal is required, place the termination at the input of the 3575A.

c. Provide good ground connections by using shielded cables equipped with BNC connectors. If shielded cables are not available, use twisted leads.

d. Keep input cables and leads as short as possible.

**3-17. Checking For Ground Loops.** To check for power-line ground loops, proceed as follows:

a. Apply a 0.2 mV to 50 mV rms, 1 Hz to 60 Hz (or other power-line frequency) signal to either or both of the 3575A inputs.

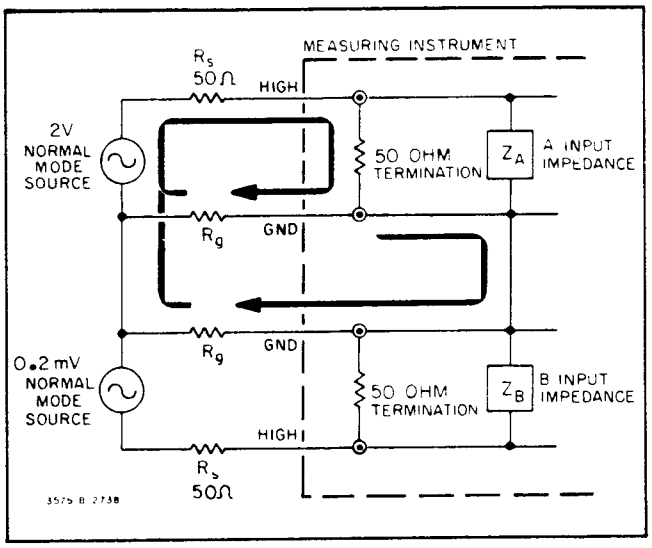



**Figure 3-4. Source-Induced Ground Loop.**

b. Set the 3575A to measure the amplitude of the applied signal and note the panel meter reading.

c. Connect a short piece of copper braid between the common terminal of the signal source and the 3575A input common (on one of the BNC input connectors).

d. Allow time for the instrument to stabilize and again note the panel meter reading.

e. If connecting the copper braid has produced a significant change (± 0.5 dB) in the reading, a ground loop is present and corrective action (Paragraph 3-12) should be taken.

*NOTE*

*A ground terminal (Item 14, Figure 3-2) is provided on the 3575A rear panel to permit external grounding. In cases where ground loops are critical and difficult to control, it is sometimes beneficial to connect a short piece of copper braid between this ground terminal and the chassis of the signal source. Factory tests have indicated, however, that the length and positioning of the copper braid can be critical. Before using this technique in a measurement application, experiment with various ground points, lead lengths and lead positions to establish a grounding method that ensures accurate, repeatable readings in your particular situation.*

3-18. To check for source induced ground loops, proceed as follows:

a. Apply a 1 V to 20 V rms, 10 Hz to 10 kHz signal to one channel and a 0.2 mV to 10 mV rms signal to the other channel.

b. Set the 3575A to measure the amplitude of the low level signal and note the panel meter reading.

c. Disconnect the high level signal from the 3575A.

d. Allow time for the instrument to stabilize and again note the low level amplitude reading.

e. If disconnecting the high level signal has produced a significant change (± 0.5 dB) in the low level reading, a ground loop is present and corrective action (Paragraph 3-16) should be taken.

### 3-19. Input Constraints.

3-20. The 80 dB dynamic range of the 3575A provides wide freedom from input constraints. In many cases, it will be possible to make all the necessary measurements without changing voltage ranges. It is important, however, to observe the maximum input levels (2 V rms or 20 V rms) indicated by the Voltage Range setting. Exceeding these input levels will cause the display to blank, the overload indicator ($A_{OL}$ or $B_{OL}$) to illuminate and can damage the instrument if the applied voltage is greater than 25 V rms or 50 V dc.

### 3-21. DC Isolation.

3-22. The 3575A inputs are equipped with coupling capacitors to provide dc isolation. The maximum dc voltage that can be safely applied to the inputs is ± 50 Vdc. Exceeding this limit can cause breakdown of the input capacitors resulting in damage to the input amplifier circuitry.

3-23. The 3575A cannot be operated in a floating condition. All Input and Output commons are connected directly to outer chassis (frame) ground which connects to earth ground through the offset pin on the power cord connector.

### 3-24. Voltage Ranges.

3-25. Each input channel is equipped with a range switch which permits selection of two overlapping voltage ranges. Input voltage limits within each range are as follows:

0.2 mV rms (- 74 dBV) to 2 V rms (+ 6 dBV)
2 mV rms (- 54 dBV) to 20 V rms (+ 26 dBV)

3-26. As long as the applied signal is within the limits of both ranges (2 mV to 2 V), either range setting can be used. Changing the voltage range setting does not affect the display resolution. For optimum accuracy, however, it is recommended that the 0.2 mV to 2 V range by used at all times unless the applied signal is greater than 2 V rms. The reason for this is that on the 2 mV to 20 V range the input signal is divided by the 20 dB input attenuator. Any noise that is generated within the 3575A, however, is not attenuated and the signal to noise ratio is decreased. Decreasing the signal to noise ratio makes the instrument more suseptable to noise which can affect the accuracy of amplitude and phase readings. It should be noted that the Phase Accuracy specifications (Table 1-1) are met only when the lowest applicable voltage range settings are used.

### 3-27. Frequency Ranges.

3-28. The broadband frequency response of the 3575A extends from 1 Hz to 13 MHz in four overlapping ranges. Frequency limits within each range are as follows:

1 Hz to 1 kHz
10 Hz to 100 kHz
100 Hz to 1 MHz
1 kHz to 13 MHz

3-29. The FREQUENCY RANGE setting determines the amount of filtering that is used throughout the instrument. The filtering, in turn, controls the frequency response and overall settling time (See Table 3-1). The frequency ranges are designed such that the lower limit of each range applies to both amplitude and phase and the upper limit applies only to phase. For example, it is possible to use the 1 Hz to 1 kHz range for all *amplitude* measurements within the frequency range of 1 Hz to 13 MHz. For most amplitude measurements, however, it is best to use one of the upper ranges to minimize settling time. The main thing to remember when making amplitude measurements is that the frequency of the input signal(s) must be above the lower limit of the selected frequency range. When measuring phase, it is necessary to observe both the upper and lower limits of each frequency range. The upper limits, which apply to phase only, are determined by noise filters which control the high frequency cutoff characteristics of the phase detector circuits. For optimum phase accuracy, it is necessary to use the frequency range that provides the greatest noise immunity *and* the required bandpass. This means that the *lowest* range that covers the frequency of the input signals must be used. It should be noted that the Phase Accuracy specifications (Table 1-1) are met only on the lowest applicable frequency range.

**Table 3-1. Typical Settling Time.**
**(following a change in input parameters)**

| Frequency Range | 100 % * Settled | 95 % * Settled | 90 % * Settled |
|---|---|---|---|
| 1 Hz - 1 kHz | 30 sec. | 20 sec. | 17 sec. |
| 10 Hz - 100 kHz | 3 sec. | 2 sec. | 1.7 sec. |
| 100 Hz - 1 MHz | 0.3 sec. | 0.2 sec. | 0.17 sec. |
| 1 kHz - 13 MHz | 30 ms. | 20 ms. | 17 ms. |

* Percent of final reading.

### 3-30. Meter Indication.

3-31. The 3575A panel meter indicates directly in dB or dBV for amplitude measurements and in degrees for phase measurements. The front panel DISPLAY switch permits selection of either AMPLITUDE or PHASE presentation.

**3-32. Amplitude Presentation.** With the DISPLAY switch in the AMPLITUDE position, the meter presentation is determined by the AMPLITUDE FUNCTION control setting. The three amplitude functions are: Log A, Log B

and Log B/A. When A or B is selected, the panel meter indicates the amplitude of the corresponding input signal in dBV (1 V rms = 0 dBV). The overall measurement range for the Log A and Log B amplitude functions is from - 74 dBV (0.2 mV rms) to + 26 dBV (20 V rms) providing a total of 100 dB in two voltage ranges. The 3575A amplitude readings are displayed with 0.1 dBV resolution over the entire measurement range. When B/A is selected, the 3575A measures the relative amplitude of (difference between) the two input signals in dB. The display range for relative measurements is from - 100 dB to + 100 dB with 0.1 dB resolution. Relative amplitude readings are displayed with respect to channel A which is the reference channel. A negative reading indicates that the signal applied to channel B is *lower* in amplitude than the signal applied to channel A. A positive reading indicates that the signal applied to channel B is *greater* in amplitude than the signal applied to channel A.

**3-33. Phase Presentation.** With the DISPLAY switch in the PHASE position, the panel meter indicates the phase difference between the two input signals in degrees. The display range for phase measurements is from - 192 degrees to + 192 degrees with 0.1 degree resolution. The ± 192 degree limits provide a ± 12 degree overrange capability which eliminates ambiguous readings in the ± 180 degree region.

**3-34. Phase Reference.** The 3575A phase readings are displayed with respect to channel A which is the reference channel. A negative phase reading indicates that B lags A; a positive phase reading means that B leads A.

3-35. With the PHASE REFERENCE switch in the + A position, the panel meter indicates the actual phase difference between the two input signals. With the PHASE REFERENCE switch in the - A position, channel A is inverted and the phase reading is offset by 180 degrees. For example, with a phase difference of + 60 degrees (B leads A) applied to the inputs and the PHASE REFERENCE switch set to the + A position, the panel meter will indicate + 60 degrees. If the PHASE REFERENCE switch is changed to the - A position, channel A will be inverted and the panel meter will indicate - 120 degrees.

3-36. Because of the ± 12 degree overrange capability, the 3575A never gives ambiguous phase readings. This means that it is not necessary to change the phase reference for measurements in the ± 180 degree region. The ability to change the phase reference is strictly a convenience feature which is useful for some measurement applications. One example of this is where it is necessary to make a continuous phase vs. frequency plot over 360 degrees of range. Consider the case where two signals are initially in phase and as frequency is varied the phase difference increases in a positive direction. With the phase reference set to + A, the plot starts out at 0 degrees and increases with frequency until the phase difference reaches approximately + 192 degrees. At this time, the 3575A reading automatically jumps to - 168 degrees and again goes more positive with frequency. The result is a discontinuous plot. By initially setting the phase reference to - A, however, a continuous plot could be obtained. The plot would start out at - 180 degrees and continue in a positive direction through + 192 degrees extending the continuous range by 180 degrees.

### 3-37. Analog Outputs.

3-38. Two BNC connectors, labeled ANALOG OUTPUT 1 and ANALOG OUTPUT 2, are located on the rear panel of the instrument. On the standard Model 3575A, ANALOG OUTPUT 2 is not used. The remaining connector, ANALOG OUTPUT 1, is connected through a 1 kilohm resistor to the analog (dc) voltage applied to the panel meter. Since this voltage is not affected by errors within the panel meter, it is more accurate than the panel meter reading. For this reason, the amplitude and phase accuracy specifications listed in Table 1-1 apply to the analog output and do not reflect the ± 3 count panel meter tolerance. The analog output voltage is defined in the accuracy specifications as 10 mV per degree for phase measurements and 10 mV per dB/dBV for amplitude measurements (with > 2 Megohm load resistance). In the Amplitude Display mode, the analog output voltage ranges from - 1 Vdc (- 100 dB) to + 1 Vdc (+ 100 dB). In the Phase Display mode the voltage ranges from - 1.92 Vdc (- 192 degrees) to + 1.92 Vdc (+ 192 degrees). The analog output resistance is 1 Kilohm and short-circuit protection is provided. To obtain an output of 10 mV per degree or 10 mV per dB/dBV, the load resistance connected to the analog output must be 2 Megohm or greater. Additional loading will not damage the instrument or degrade the linearity but it will reduce the output voltage by an amount proportional to the load resistance.

### 3-39. Dual Analog Outputs (Options 001 through 003).

3-40. For instruments equipped with dual panel meters, ANALOG OUTPUT 1 is connected to the left-hand (facing the front panel) panel meter (amplitude) and ANALOG OUTPUT 2 is connected to the right-hand panel meter (phase). The analog output voltages correspond with the respective panel meter readings and can be used for simultaneous amplitude and phase plotting. For further information concerning Options 001–003, refer to Paragraph 3-64.

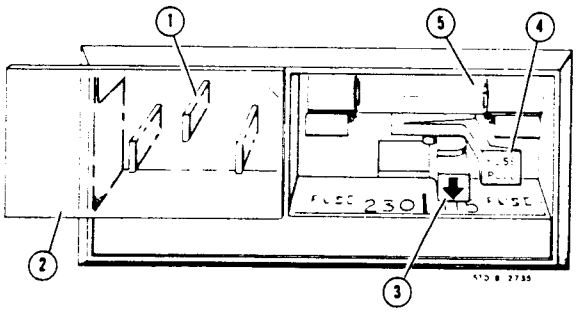
## 3-41. BASIC OPERATING PROCEDURE.

### 3-42. Instrument Turn On.

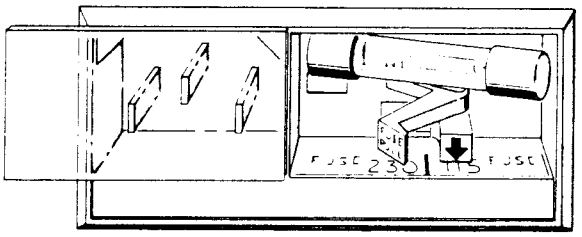
a. Refer to Figure 3-5 and perform the following:

1) Remove the fuse and set the line selector switch to correspond with the line voltage to be used (115 V or 230 V).

2) Replace the fuse using a 0.6A, 250 V slo-blo for 115 V operation or a 0.3A, 250 V slo-blo for 230 V operation.

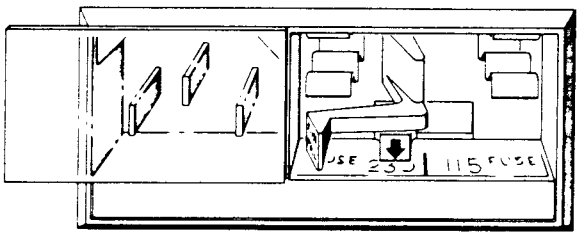



1. POWER CORD RECEPTACLE (A18P1)
2. FUSE COMPARTMENT COVER
3. 115 V/230 V SELECTOR SWITCH (A18S1)
4. FUSE PULLER
5. LINE FUSE (A18F1): 0.6 A, 250 V SLO-BLO (115 V OPERATION)
   0.3 A, 250 V SLO-BLO (230 V OPERATION)



a. DISCONNECT POWER CORD AND SLIDE THE COVER TO THE LEFT TO GAIN ACCESS TO THE FUSE COMPARTMENT.

b. REMOVE THE LINE FUSE BY PULLING OUTWARD ON THE FUSE PULLER.



c. WITH THE FUSE PULLER POSITIONED AS SHOWN, SET THE 115 V/230 V SELECTOR SWITCH TO THE POSITION THAT CORRESPONDS WITH THE LINE VOLTAGE TO BE USED.

d. REPLACE THE LINE FUSE USING A 0.6 A, 250 V SLO-BLO FOR 115 V OPERATION OR A 0.3 A, 250 V SLO-BLO FOR 230 V OPERATION.

**Figure 3-5. Power Input Module A, B and C.**

b. Connect the detachable ac power cord to the rear panel power receptacle and to the power source (115 V or 230 V, 48 Hz to 440 Hz).

c. Set the LINE switch to the ON position. The panel meter display will illuminate. With no inputs applied to the 3575A, the instrument will respond to extraneous pickup and residual noise. For this reason, the display may not stabilize until inputs are applied.

## 3-43. Amplitude Measurements.

**3-44. Log A and Log B Measurements.** The single channel amplitude functions A or B, permit direct measurement of either input level in dBV. These readings can be converted to ac volts using the graph shown in Figure 3-6. To measure the level applied to either input channel, proceed as follows:

a. Set the DISPLAY switch to the AMPLITUDE position.

b. Set the AMPLITUDE FUNCTION switch to A or B depending on which input is to be measured.

c. Set the Voltage Range and FREQUENCY RANGE switches to appropriate settings as outlined in Paragraphs 3-24 and 3-27.

d. Apply signal to the appropriate input channel.

e. Allow time for the reading to stabilize.

f. Observe the amplitude reading in dBV.

g. If desired, convert the dBV reading to rms volts using the graph shown in Figure 3-6.

**3-45. Relative Measurements (Log B/A).** In the B/A amplitude function, the 3575A measures the relative amplitude of the two input signals in dB. This function is particularly useful for measuring gain, attenuation and frequency response. The use of simultaneous comparison eliminates the need for separate input and output measurements and provides relative readings that are independent of source variations.

3-46. Because the two input channels are totally independent, relative measurements can be made between two signals that differ in frequency. It should be noted, however, that both input frequencies must be *above* the lower limit of the selected frequency range (see Paragraph 3-27).

3-47. For relative measurements using the B/A function, proceed as follows:

a. Set the DISPLAY switch to the AMPLITUDE position.

b. Set the AMPLITUDE FUNCTION switch to B/A.

c. Set the Voltage Range and FREQUENCY RANGE switches as outlined in Paragraphs 3-24, 3-27 and 3-46.

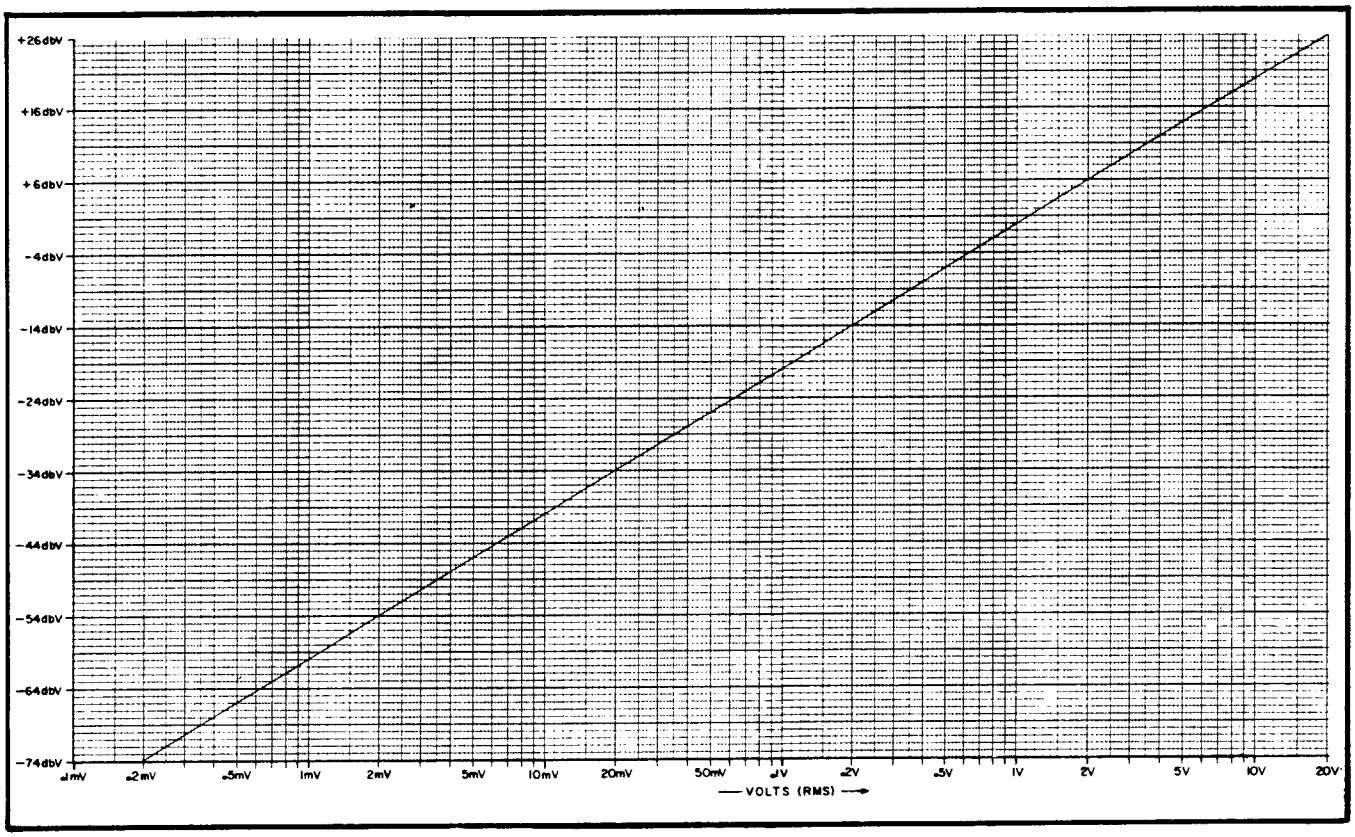



**Figure 3-6. dBV to Volts Conversion.**

d. Remembering tnat channel A is the reference channel, connect the signals to be measured to the 3575A Input connectors.

e. Allow time for the reading to stabilize.

f. Observe the relative amplitude reading in dB. A negative reading indicates that B is lower than A; a positive reading means that B is greater than A.

g. When making relative measurements ensure that the input levels are within the limits of the voltage range settings being used.

### 3-48. Phase Measurements.

3-49. With the DISPLAY switch in the PHASE position, the 3575A measures the phase difference between the two input signals in degrees. To measure phase, proceed as follows:

a. Set the DISPLAY switch to the PHASE position.

b. Set the PHASE REFERENCE switch to + A or as outlined in Paragraph 3-34.

c. Set the Voltage Range and FREQUENCY RANGE switches as outlined in Paragraphs 3-24 and 3-27.

d. Connect the signals to be measured to the 3575A Input connectors.

e. Allow time for the reading to stabilize.

f. Observe the phase reading. Since A is the reference channel, a negative reading indicates that B lags A; a positive reading indicates that B leads A.

**3-50. Effects of Harmonic Distortion on Phase Readings.** In the 3575A, phase difference is measured between the zero crossing points of the applied signals. If an applied signal contains harmonics of the fundamental frequency, the zero crossings may be shifted with respect to a pure sine wave. If the instrument responds to the false crossings introduced by the distortion, an erroneous offset will appear in the phase reading.

3-51. The amount of error introduced by harmonic distortion depends on the magnitude, phase and order of the harmonics. Harmonics that are in phase with the fundamental (such as in a square wave) do not change the zero crossing points and do not affect the phase reading. In the 3575A, the effects of even harmonics are cancelled by two phase detectors that operate 180 degrees out of phase. For this reason, even harmonics, regardless of their phase, do not affect the phase reading. This leaves only odd harmonics that are out of phase with the fundamental.

3-52. The amount of error introduced by odd harmonic distortion again depends on the magnitude and phase of the harmonics. The largest error occurs when the odd harmonics are 90 degrees out of phase with the fundamental. In

this case, the distortion is at it's peak amplitude when the fundamental is at the zero crossing point.

3-53. The graph shown in Figure 3-7 can be used to determine the approximate worst-case error introduced by odd, out-of-phase harmonics. As indicated in the graph, the worst-case error for odd harmonics 40 dB below the fundamental is approximately 0.57 degrees.

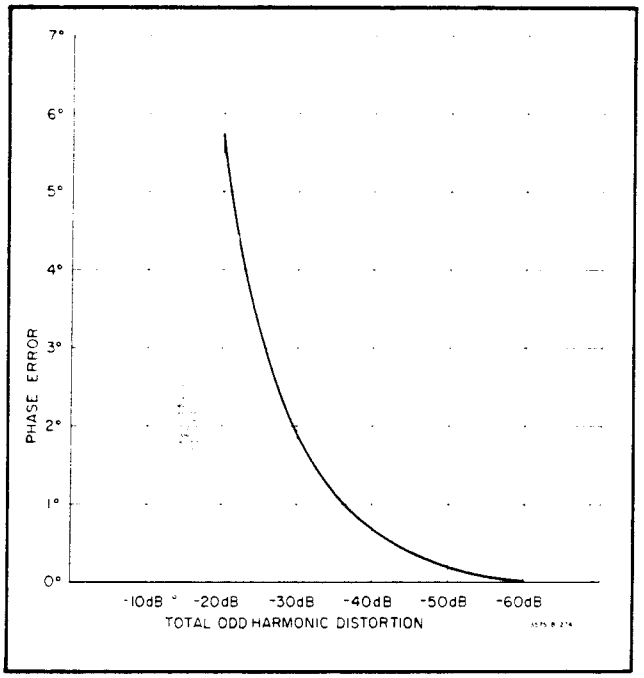



**Figure 3-7. Worst Case Error Produced by Odd Harmonics.**

**3-54. Effects of Noise on Phase Readings.** The 3575A uses a unique phase measuring scheme which minimizes the effects of noise by a process of detection, cancellation and correction. This, in conjunction with the broadband filtering that is used throughout the instrument, virtually eliminates ambiguous readings and 180 degree errors. This does not mean, however, that the effects of noise are completely eliminated. With applied signal to noise ratios of $<30$ dB, noise can produce erroneous offsets. The amount of offset depends of the signal to noise ratio while the offset polarity depends on which channel the noise appears. The effects of noise are minimized under the following conditions:

a. When the noise level on both channels is more than 30 dB below the signal level (signal to noise ratio $>30$ dB).

b. When readings are more than 10 degrees away from 0 degrees, ± 90 degrees and ± 180 degrees and the noise is on the channel indicated (by shaded areas) in Table 3-2.

**3-55. Effects of Source Impedance on Phase Readings.** Due to the internal shunt capacitance and any external cable capacitance connected to the 3575A inputs, the phase of an applied signal can be affected by the impedance of the signal source or network under test. This

**Table 3-2. Effects of Noise Minimized.**

| | - 170° to - 100° | - 80° to - 10° | 10° to 80° | 100° to 170° |
|---|---|---|---|---|
| Chan A | | | | |
| Chan B | | | | |

can be illustrated by a simple R/C network such as the one shown in Figure 3-8. In Figure 3-8, the source impedance is represented by a resistor ($R_S$) and the internal shunt capacitance is represented by a capacitor ($C_S$). The overall shunt capacitance is increased by $C_X$ which represents the external cable capacitance between the source and the 3575A input. The amount of phase shift developed across the shunt capacitance depends on three variables: the effective shunt capacitance ($C_S + C_X$), the source impedance ($R_S$) and the frequency of the applied signal ($F_O$). Increasing any of these variables increases the phase shift of the network. If the source impedance is resistive, the phase shift can be calculated using the following formula:

$$\text{Tan.}\ \emptyset = \frac{R_S}{X_{CS}}$$

Where: $\emptyset$ = phase shift in degrees
$R_S$ = source resistance
$X_{CS}$ = reactance of the effective shunt capacitance ($C_S + C_X$) where $C_S = 30$ pF and $C_X$ = external cable capacitance (approximately 20 pF per foot for RG - 58/U)

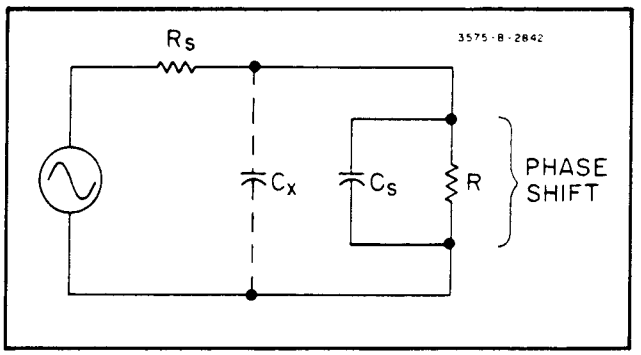



**Figure 3-8. Simple RC Network.**

3-56. Since the internal shunt capacitance of channel A is closely matched to that of channel B, the phase measurement accuracy will not be affected if the source impedance and the external cable capacitance is the same on both channels. In this case, both channels exhibit the same amount of phase shift and the relative phase of the applied signals remains unchanged.

3-57. In most phase measurement applications it is impractical to maintain the same source impedance and cable

capacitance on both channels. The effects of source impedance can be minimized, however, by the use of 10 Megohm 10:1 divider probes (-hp- 10004A) which reduce the effective shunt capacitance to approximately 10 pF.

3-58. Table 3-3 can be used to determine the reactance of the 10 pF probe capacitance over the entire frequency spectrum. A general "rule of thumb" is that the capacitive reactance of the 10 pF probe should be at least 100 times the *difference* between the two source impedances at the highest operating frequency. If this rule is applied, the maximum or "worst-case" error will be less that 0.6 degrees. If 10 pF divider probes are used and the two source impedances are primarily resistive, the phase error can be approximated using the following formula:

$$\text{Tan.}\,\emptyset = \frac{|R_{sa} - R_{sb}|}{X_c}$$

Where: $\emptyset$ = phase error in degrees
$R_{sa}$ = source resistance of channel A
$R_{sb}$ = source resistance of channel B
$X_c$ = reactance of 10 pF divider probe at the operating frequency

### 3-59. Using 10:1 Divider Probes.

3-60. The 3575A input channels are designed to permit the use of 10 Megohm, 10 pF Voltage Divider Probes (-hp-10004A). These probes can be used to extend the maximum input levels to 200 V rms and the overall operating range to 120 dB. Voltage divider probes also reduce the effective shunt capacitance to approximately 10 pF and thereby minimize errors due to source impedance (Paragraph 3-55).

3-61. When using 10:1 divider probes, the following guidelines should be observed:

a. Use 10 Megohm, 10 pF Divider Probes (-hp- 10004A or equivalent) only. Other probes can create errors particularly when measuring phase at high frequencies.

b. Before using 10:1 divider probes, compensate the probes as outlined in Paragraph 3-62.

c. Do not use a 10:1 divider probe on one channel and a direct input to the other channel.

d. Use the lowest voltage range that provides the required measurement capability.

e. Note that when 10:1 divider probes are used, the single channel amplitude readings (Log A and Log B) will be offset by - 20 dBV e.g., 1 V rms applied to probe will measure - 20 dBV rather than 0 dBV. Relative readings (B/A) will not be offset if identical probes are used.

**3-62. Probe Compensation.** Before using 10:1 divider probes it is necessary to adjust the probes for optimum flatness and identical phase characteristics. Once the probes are properly adjusted they should not require further attention unless they are interchanged or inadvertently misadjusted. It is good practice, however, to perform periodic verification checks to ensure that optimum adjustment is maintained.

3-63. The following probe adjustments should be performed with a 1 V rms sine wave applied to both probes:

REQUIRED EQUIPMENT: Test Oscillator (-hp- 651B)
50 Ohm Feedthru Termination (-hp- 11048B)

a. Connect 50 ohm output of test oscillator, terminated in 50 ohm load, to both 3575A input probes.

**Table 3-3. Reactance of 10 pF Probe.**

| Frequency | Reactance | Frequency | Reactance | Frequency | Reactance | Frequency | Reactance |
|---|---|---|---|---|---|---|---|
| 10 Hz | 1591 M | 700 Hz | 22.74 M | 30 kHz | 530 K | 800 kHz | 19.9 K |
| 20 Hz | 795.7 M | 800 Hz | 19.89 M | 40 kHz | 398 K | 900 kHz | 17.7 K |
| 30 Hz | 530.5 M | 900 Hz | 17.68 M | 50 kHz | 318 K | | |
| 40 Hz | 397.9 M | | | 60 kHz | 265 K | 1 MHz | 15.9 K |
| 50 Hz | 318.3 M | 1 kHz | 15.91 M | 70 kHz | 227 K | 2 MHz | 7.96 K |
| 60 Hz | 265.3 M | 2 kHz | 7.96 M | 80 kHz | 199 K | 3 MHz | 5.30 K |
| 70 Hz | 227.4 M | 3 kHz | 5.30 M | 90 kHz | 177 K | 4 MHz | 3.98 K |
| 80 Hz | 198.9 M | 4 kHz | 3.98 M | | | 5 MHz | 3.18 K |
| 90 Hz | 176.8 M | 5 kHz | 3.18 M | 100 kHz | 159 K | 6 MHz | 2.65 K |
| | | 6 kHz | 2.65 M | 200 kHz | 79.6 K | 7 MHz | 2.27 K |
| 100 Hz | 159.1 M | 7 kHz | 2.27 M | 300 kHz | 53.0 K | 8 MHz | 1.99 K |
| 200 Hz | 79.57 M | 8 kHz | 1.99 M | 400 kHz | 39.8 K | 9 MHz | 1.77 K |
| 300 Hz | 53.05 M | 9 kHz | 1.77 M | 500 kHz | 31.8 K | | |
| 400 Hz | 39.79 M | | | 600 kHz | 26.5 K | 10 MHz | 1.59 K |
| 500 Hz | 31.83 M | 10 kHz | 1.59 M | 700 kHz | 22.7 K | 13 MHz | 1.22 K |
| 600 Hz | 26.53 M | 20 kHz | 796 K | | | | |

b. Set the 3575A controls as follows:

DISPLAY ..... AMPLITUDE
Voltage Range ..... 0.2 mV to 2 V (both channels)
AMPLITUDE FUNCTION ..... A
FREQUENCY RANGE ..... 100 - 1 M
PHASE REFERENCE ..... A

c. Set the test oscillator for an output of 1 V rms, 100 Hz.

d. Record the channel A amplitude reading:__dBV.

e. Establish a reference level on the meter of the test oscillator and use the oscillator amplitude control to maintain this reference level whenever the frequency is varied.

f. Set the test oscillator frequency to 1 MHz.

g. Adjust the channel A probe for the same reading recorded in Step d.

h. Repeat Steps e through g until optimum adjustment is obtained.

i. Set the test oscillator frequency to 1.5 kHz.

j. Set the 3575A DISPLAY switch to PHASE.

k. Adjust the channel B probe for a phase reading of 0 degrees ± 0.2 degrees.

l. Set the 3575A DISPLAY switch to AMPLITUDE; set the AMPLITUDE FUNCTION switch to B/A.

m. Set the test oscillator frequency to 1 MHz.

n. The B/A reading should be 0 dB ± 0.2 dB. If it is not, perform the following:

1) Repeat the probe adjustment procedure.

2) Replace the probes one at a time to determine if the problem is caused by faulty probes.

3) Perform the adjustment procedures outlined in Section V.

## 3-64. OPTIONS.

## 3-65. Option 001.

3-66. The 3575A Option 001 is equipped with dual panel meters to provide simultaneous amplitude and phase presentations. This option is also equipped with two analog outputs to permit amplitude vs. phase plotting.

3-67. In the 3575A Option 001, the left-hand (facing the front panel) panel meter always indicates amplitude. This panel meter is controlled by the AMPLITUDE FUNCTION switch which, as in the standard Model 3575A, permits selection of Log A, Log B or Log B/A.

3-68. The right-hand panel meter can indicate amplitude or phase depending on the position of the AMPLITUDE B/PHASE switch. With the switch in the AMPLITUDE B position, the right-hand panel meter indicates the amplitude of the signal applied to channel B (B dBV). Since the left-hand panel meter can indicate A dBV, B dBV or B/A, the following amplitude functions can be displayed simultaneously on the two panel meters:

| Amplitude Function | Left-hand Panel Meter | Right-hand Panel Meter |
|---|---|---|
| A | A dBV | B dBV |
| B | B dBV | B dBV |
| B/A | B/A (dB) | B dBV |

3-69. With the AMPLITUDE B/PHASE switch in the PHASE position, the right-hand panel meter indicates phase. The phase readings are controlled by the PHASE REFERENCE switch and are displayed as outlined in Paragraphs 3-33 through 3-36.

**3-70. Analog Outputs.** The 3575A Option 001 is equipped with two rear panel output (BNC) connectors labeled ANALOG OUTPUT 1 and ANALOG OUTPUT 2. Analog Output 1 is connected with the left-hand (amplitude) panel meter and Analog Output 2 is connected with the right-hand panel meter. The dc voltages at the analog outputs correspond with the respective panel meter readings as outlined in Paragraph 3-37.

## 3-71. Options 002 and 003.

*NOTE*

*The 3575A Options 002 and 003 are identical except that Option 003 instruments use high-true logic for the BCD outputs. In all other respects, the following information for Option 002 instruments also applies to Option 003*

3-72. The 3575A Option 002 is a fully programmable instrument with dual BCD outputs and a complete remote control capability. Like the Option 001, the 3575A Option 002 is equipped with dual panel meters for simultaneous amplitude and phase presentations. Dual analog outputs are provided along with the BCD outputs to make the instrument compatible with various types of control systems and recording devices.

**3-73. Remote Logic.** The 3575A Option 002 uses ground true logic for the BCD outputs and remote control lines. Logic levels for the BCD outputs are as follows: *

True (1) = 0 V to + 0.4 V, 12 mA maximum
False (0) = + 2.4 V to + 5 V, 0.4 mA maximum

Logic levels for the remote control lines are as follows:

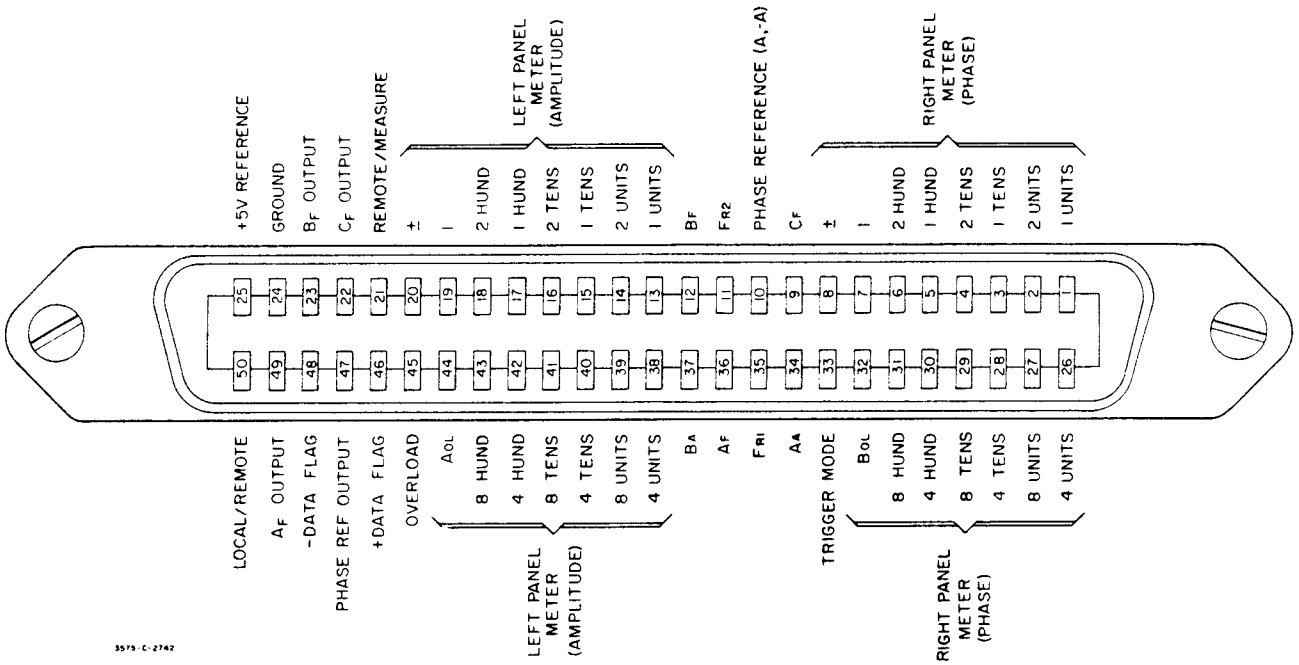
True (1) = ground or - 0.5 V to + 0.4 V, 1.6 mA maximum
False (0) = open or + 2.4 V to + 5 V (5.6 K pullup resistance)

* Option 003 instruments use high-true logic for BCD outputs.

**3-74. Remote Pin Connections.** Figure 3-9 illustrates the 3575A Option 002 Interface connector as viewed from the rear of the instrument. The connector diagram and the table within the figure provides complete programming information. A 50-pin mating connector (-hp- 1251-0086)* and a 46-conductor cable are required for a complete remote programming capability (including remote control lines, BCD outputs, overload outputs, data flags, + 5 V and circuit ground).

**CAUTION**

*THE REMOTE INPUT AND OUTPUT LINES IN THE 3575A OPTION 002 ARE NOT ISOLATED. ALL INPUT AND OUTPUT LINES ARE REFERENCED TO CIRCUIT GROUND WHICH IS PERMANENTLY CONNECTED TO THE CHASSIS. THE CHASSIS CONNECTS TO EARTH GROUND THROUGH THE OFFSET PIN ON THE POWER-CORD CONNECTOR.*




| Line | J1 Pin No. | Control Data |
|---|---|---|
| "±" | 8 | 1 = +; 0 = - (Phase Polarity) |
| "±" | 20 | 1 = +; 0 = - (Amplitude Polarity) |
| $A_{OL}$ | 44 | 1 = Overload on Channel A |
| $B_{OL}$ | 32 | 1 = Overload on Channel B |
| Overload | 45 | 1 = Overload on Channel A OR B |
| + Data Flag | 46 | 1 = Data Not Ready; 0 = Data Ready |
| - Data Flag | 48 | 1 = Data Ready; 0 = Data Not Ready |
| Local/Remote | 50 | 1 = Remote; 0 = Local |
| Remote/Measure | 21 | 1 = Measure (> 1 ms momentary pulse) |
| Trigger Mode | 33 | 1 = Non-Delayed, 0 = Delayed |
| $A_A$ | 34 | 1 = 0.2 mV to 2 V; 0 = 2 mV to 20 V (Channel A Voltage Range) |
| $B_A$ | 37 | 1 = 0.2 mV to 2 V; 0 = 2 mV to 20 V (Channel B Voltage Range) |

| Line | J1 Pin No. | Control Data | | |
|---|---|---|---|---|
| Amplitude Function ($A_F$, $B_F$) | 36 ($A_F$) | $A_F$ | $B_F$ | Function |
| | | 0 | 0 | B/A |
| | 12 ($B_F$) | 0 | 1 | A dBV |
| | | 1 | 0 | B dBV |
| Display ($C_F$) | 9 | 1 = Phase; 0 = Amplitude B | | |
| Frequency Range (FR1, FR2) | 35 (FR1) | FR1 | FR2 | Range |
| | | 0 | 0 | 1 - 1 K |
| | 11 (FR2) | 0 | 1 | 10 - 100 K |
| | | 1 | 0 | 100 - 1 M |
| | | 1 | 1 | 1 K - 13 M |
| Phase Ref. | 10 | 1 = - A; 0 = A | | |

REMOTE LOGIC:

** OUTPUTS: True (1) = 0 V to + 0.4 V, 12 mA maximum load
False (0) = + 2.4 V to + 5 V, 0.4 mA maximum load

INPUTS: True (1) = ground or - 0.5 V to + 0.4 V, 1.6 mA maximum
False (0) = open or + 2.4 V to + 5 V (5.6 K pullup resistance)

**Figure 3-9. Remote Pin Connections.**

* Cinch No. 57-30500-375
** Option 003 instruments use high-true logic for BCD outputs.

**3-75. Local/Remote Control.** Remote control operation is selected by applying a continuous ground (or - 0.5 V to + 0.4 V) to the Local/Remote control line (J1 pin 50). When ground is applied to the Local/Remote line, the following things take place within the 3575A:

a. The front panel controls (except LINE switch) are disabled.

b. The remote control lines are enabled.

c. The internal sampling in both panel meters is disabled (external triggering must be used).

d. The external trigger and flag timing circuits are enabled.

e. The "Remote" (REM) annunciators on the panel meters illuminate.

**3-76. Remote Control Lines.** In the remote control mode, the 3575A Option 002 will accept parallel binary instructions applied to the remote control lines. Since internal storage is not provided, the control lines must be held at ground (or - 0.5 V to + 0.4 V) by the external controller whenever a "true" condition is required. When remote operation is selected without inputs to the remote control lines, the lines are held in a "false" condition by the internal logic circuitry. With all control lines false, the control settings are programmed as follows:

| | |
|---|---|
| AMPLITUDE B/PHASE | AMPLITUDE B |
| Voltage Range | 2 mV to 20 V (both channels) |
| FREQUENCY RANGE | 1 - 1 K |
| AMPLITUDE FUNCTION | B/A |
| PHASE REFERENCE | A |

**3-77. BCD Outputs.** The 3575A Option 002 is equipped with separate BCD outputs for the two panel meters. These outputs provide parallel BCD information that corresponds with the respective panel meter readings. The BCD outputs each consist of three 8-4-2-1 BCD-coded digits, a single-line overrange ("1") digit and a single-line polarity indicator. Unlike the remote control lines, the BCD outputs are always enabled and can be used in the local or remote control mode.

**3-78. Overload Outputs.** There are three overload indicator lines available at pins 32, 44 and 45 of the Interface connector. The $A_{OL}$ line (J1 pin 44) goes low when channel A is overloaded and the $B_{OL}$ (J1 pin 32) goes low when channel B is overloaded. The third line, labeled "overload" (J1 pin 45), goes low when either or both channels are overloaded. Since the overload outputs are not stored functions, they will automatically return to the "false" condition (+ 5 V) when the overload is removed.

**3-79. External Triggering and Flag Timing Sequence.** As previously indicated the internal sampling in both panel meters is disabled when ground is applied to the Local/Remote control line. This means that external triggering must be used to obtain sucessive meter readings or BCD outputs in the remote control mode.

3-80. In the 3575A Option 002, the external triggering circuit operates in conjunction with the flag timing circuit to allow adequate settling time, trigger the panel meters and provide a "data ready" flag to the external controller. The timing sequence is initiated by an external trigger pulse which is applied to the Remote Measure line (J1 pin 21). The duration of the timing sequence depends on the condition of the Trigger Mode line (J1 pin 33) which permits selection of two modes of operation: the Delayed Mode and Non-Delayed Mode.

*NOTE*

*The Remote Measure command must be delayed for at least 0.5 ms following any change that affects the programmed state of the instrument.*

**3-81. Delayed Mode.** When the Trigger Mode line is held in a "false" condition (open or + 2.4 V to + 5 V), the timing sequence is as shown in Figure 3-10. In Figure 3-10, the Remote Measure line is pulled low at T0 by the external controller. This initiates a variable delay period (determined by the Frequency Range setting) and sets the + and - Data Flags. At the end of the variable delay (T1), a 600 ms delay is initiated and, at the same time, a 600 ms trigger pulse is applied to the panel meters. At the end of the 600 ms delay (T2) both Data Flags are reset to indicate that data is ready.

3-82. The total time required to obtain a reading (T0 to T2) is equal to 600 ms plus the variable delay period determined by the Frequency Range setting. The approximate *total* delay times on each frequency range are as follows:

| Frequency Range | Total Delay |
|---|---|
| 1 - 1 K | 33 sec. |
| 10 - 100 K | 4 sec. |
| 100 - 1 M | 1.1 sec. |
| 1 K - 13 M | 0.66 sec. |

3-83. The purpose of the variable delay in the timing sequence is to allow time for the instrument to stabilize before a reading is taken. Since the times allotted by the variable delay are maximum, the instrument will often stabilize before the end of the delay period. This depends on the change in input parameters or control settings prior to the Remote/Measure pulse. In some applications such as swept measurements where readings are taken after slight changes in input parameters, it may be desirable to speed up the measurement process by omitting the variable time delay. This can be accomplished by holding the Trigger

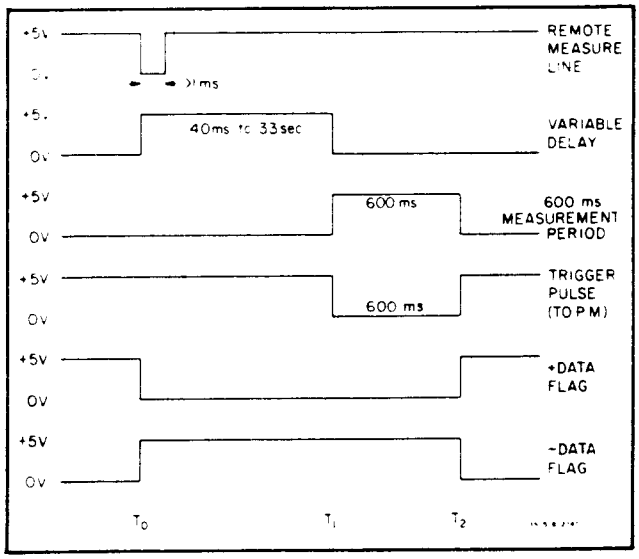



Figure 3-10. Flag Timing Delayed Mode.

Mode line in a "true" condition (gnd. or -0.5 V to +0.4 V). When the Trigger Mode line is grounded, the timing sequence is in the Non-Delayed Mode which operates as shown in Figure 3-11.

**3-84. Non-Delayed Mode.** In Figure 3-11, the Remote Measure line is pulled low at T0 by the external controller. This immediately initiates the 600 ms delay, triggers the panel meters and sets the + and - Data Flags. At the end of the 600 ms delay (T1), the Data Flags are reset to indicate that a reading has been taken.

**3-85. Remote Measure Rate.** As indicated in preceeding paragraphs, the time required to obtain a reading depends on the selected mode of operation. In the Delayed Mode, the time varies from 0.1 second to 33 seconds as a function of the Frequency Range setting. In the Non-Delayed Mode, the time is fixed at approximately 600 ms. In order to obtain successive readings at a fixed rate, the time between Remote Measure pulses must be greater than the total delay period. For example, in the Non-Delayed Mode the 600 ms delay period allows a maximum of 1.6 readings per second.

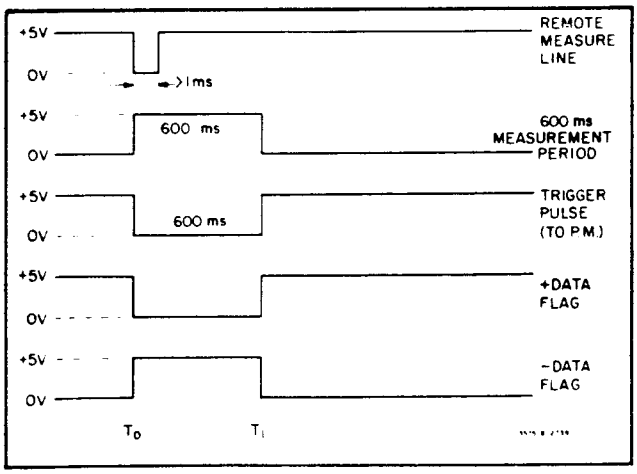



Figure 3-11. Flag Timing Non-Delayed Mode.

In the Delayed Mode, 0.66 sec. allows 1.5 readings per second, 1.1 sec. allows 54 readings per minute, 4 sec. allows 15 readings per minute and 33 seconds allows 1.8 readings per minute. In all cases, the Remote Measure pulse width must be greater than 1 ms and less than the total delay period.

**3-86. Optional Control Scheme.** For some applications, it is convenient to control the instrument from the front panel and, at the same time, use external triggering and the flag timing functions. To allow this, a jumper is provided on the Interface Assembly (A16B, Schematic No. 9). With the jumper connected between points 1 and 2 (normal), grounding the Local/Remote control line disables the front panel controls, enables the remote control lines and enables the external trigger and flag timing circuits. With the jumper connected between points 1 and 3, the front panel controls are enabled and the remote control lines are disabled regardless of the condition of the Local/Remote control line. The external triggering and flag timing functions can then be used along with the front panel controls by grounding the Local/Remote control line.

## 3-87. USING A PRINTER.

3-88. The 3575A Option 002 output lines are compatible with -hp- Digital Recorder Models 5050B and 5055A. These printers can be connected directly to the 3575A Interface connector using the -hp- 562A-16C printer cable. Complete interfacing data is presented in Section II, Paragraph 2-29.

### 3-89. Triggering.

3-90. When using a printer, it is necessary to supply a ground-true (>1 ms) Remote Measure command to the 3575A each time a printout is required (see Paragraphs 2-30 and 3-80). The Remote Measure command sets the Data Flags and initiates the timing cycle within the 3575A. The printer receives a "print" command when the Data Flags are reset at the end of the timing cycle. Unless special arrangements have been made to ground the Trigger Mode line, the 3575A will remain in the Delayed mode and the "print" command will be transmitted at the end of the delay period. The delay period varies from approximately 33 seconds to 0.66 second as a function of the Frequency Range setting. If the Trigger Mode line is grounded, the "print" command will be transmitted approximately 600 ms after the leading edge of the Remote Measure pulse.

### 3-91. Printout.

3-92. The -hp- Models 5050B and 5055A Digital Recorders provide a ten-column printout. The printer columns are numbered from right to left and the 3575A output data is printed as follows:

**3-93. Right-Hand Panel Meter.** The "units", "tens" and "hundreds" digits for the right-hand (phase) panel meter are printed in columns 1, 2 and 3, respectively. The overrange ("1") digit, polarity sign ("±") and B overload ($B_{OL}$) outputs are printed in decimal-coded form in column 4. The coding for column 4 is listed in Table 3-4.

**Table 3-4. Printer Column 4 Coding.**

| Column 4 Printout | "1" Overrange | "±" Polarity | B Overload |
|---|---|---|---|
| 0 | 0 | - | No |
| 1 | 1 | - | No |
| 2 | 0 | + | No |
| 3 | 1 | + | No |
| 4 | 0 | - | Yes |
| 5 | 1 | - | Yes |
| 6 | 0 | + | Yes |
| 7 | 1 | + | Yes |

**3-94. Unused Columns.** When a printer is connected directly to the 3575A using the -hp- 562A-16C printer cable, the eight lines that control printer columns 5 and 6 are held at +5 Vdc (false) by pullups within the 3575A. For this reason, columns 5 and 6 should always be zero.

**3-95. Left-Hand Panel Meter.** The "units", "tens" and "hundreds" digits for the left-hand panel meter are printed in columns 7, 8 and 9 respectively. The overrange ("1") digit, polarity sign ("±"), A overload ($A_{OL}$) and "overload" (A OR B) outputs are printed in decimal-coded form in column 10. The coding for column 10 is listed in Table 3-5.

**Table 3-5. Printer Column 10 Coding.**

| Column 10 Printout** | "1" Overrange | "±" Polarity | A Overload | A OR B Overload |
|---|---|---|---|---|
| 0 | 0 | - | No | No |
| 1 | 1 | - | No | No |
| 2 | 0 | + | No | No |
| 3 | 1 | + | No | No |
| 8 | 0 | - | No | Yes |
| 9 | 1 | - | No | Yes |
| + | 0 | + | No | Yes |
| - | 1 | + | No | Yes |
| V | 0 | - | Yes | Yes |
| A | 1 | - | Yes | Yes |
| Ω | 0 | + | Yes | Yes |
| * | 1 | + | Yes | Yes |

** Digits 4, 5, 6 and 7 represent illegal states.

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# SECTION IV
# THEORY OF OPERATION

## 4-1. INTRODUCTION.

4-2. The Hewlett-Packard Model 3575A Gain-Phase Meter is a compact, wide-range instrument which measures the amplitude and phase relationships between two input signals. The major features of the instrument include 1 Hz to 13 MHz frequency response (four ranges), 80 dB dynamic range, digital readout plus a highly effective detection scheme which ensures accurate phase measurements in the presence of noise and distortion.

4-3. The 3575A is equipped with a front panel Display switch which permits selection of amplitude or phase presentation. In the Amplitude Display mode, any one of three amplitude functions can be selected. These amplitude functions are Log A, Log B and Log B/A. When Log A or Log B is selected, the instrument measures the logarithmic amplitude of the corresponding input signal in dBV (1 V rms = 0 dBV). Input levels from - 74.0 dBV (0.2 mV rms) to + 26.0 dBV (20 V rms) can be measured with 0.1 dBV resolution in two voltage ranges. When Log B/A is selected, the 3575A measures the relative amplitude of the two input signals in dB. The relative measurement range is from - 100.0 dB to + 100.0 dB with 0.1 dB resolution.

4-4. In the Phase Display mode, the 3575A measures the phase difference between two input signals. Phase differences from - 180 degrees to + 180 degrees (± 12 degrees overrange) can be measured with high accuracy and 0.1 degree resolution over the entire frequency spectrum. Due to the wide operating range of the instrument, phase measurements can be made between two signals that differ in amplitude by as much as 100 dB. The 3575A employs a sophisticated phase measuring technique which minimizes the effects of noise and distortion and completely eliminates ambiguous readings and 180 degree errors.

## 4-5. SIMPLIFIED BLOCK DIAGRAM DESCRIPTION.

4-6. Refer to the Simplified Block Diagram (Figure 4-1) for the following discussion.

4-7. The 3575A consists basically of two Input Channels, a Phase Detector, Function Switching, Phase Control Logic, an Output Filter and a Digital Panel Meter. The Input

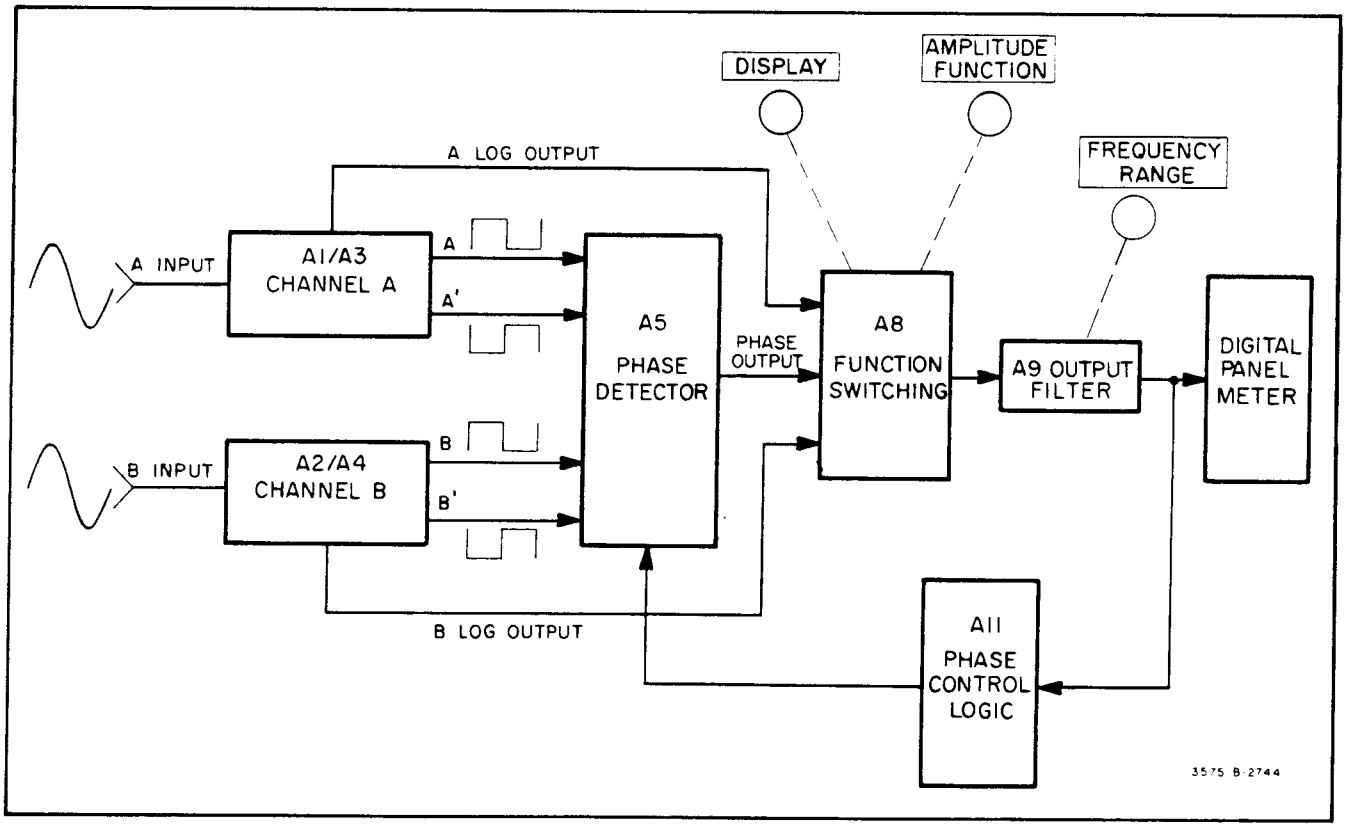



Figure 4-1. Simplified Block Diagram.

Channels condition the input signals, furnish square-wave outputs that are used for phase measurements and produce logarithmic outputs that are used for amplitude measurements. The logarithmic outputs are applied directly to the Function Switching circuits where they are individually selected (Log A or Log B) or summed (Log B/A) and applied to the Output Filter and Panel Meter in the Amplitude Display mode. The square-wave outputs are used to control J-K flip-flops in the Phase Detector which provides a dc output voltage proportional to the phase difference between the two input signals. This dc output is coupled through the Function Switching circuits and Output Filter to the Panel Meter and Phase Control Logic in the Phase Display mode. The Phase Control Logic senses the magnitude and polarity of the phase output voltage and, in turn, applies dc offsets to the Phase Detector to maintain a correct phase reading. The Digital Panel Meter is a dc digital voltmeter which converts the analog amplitude or phase information to a 3 1/2 digit 7 segment bar matrix.

## 4-8. FUNCTIONAL DESCRIPTION.

### 4-9. Input Channels.

4-10. Refer to the Functional Block Diagram (Figure 7-1). Since the two input channels are identical, the following discussion applies to both channels.

4-11. Each Input Channel is comprised of an Input Attenuator, a Preamplifier, a Log Amplifier, a Synchronous Rectifier and a Level Translator. The Input Attenuator is controlled by the front panel voltage range switch and provides either 0 dB (0.2 mV to 2 V range) or 20 dB (2 mV to 20 V range) of attenuation. The Preamplifier provides Unity gain and impedance conversion between the Input Attenuator and the input of the Log Amplifier. The Log Amplifier converts the input level to a logarithmic value, supplies a limited signal to the Level Translator and furnishes a logarithmic output which is applied to the Synchronous Rectifier. The Level Translator conditions the applied signal and produces two square-wave outputs that are equal in amplitude and 180 degrees out of phase. These square-wave outputs (designated A, A', B and B') are applied directly to the Phase Detector circuitry. The logarithmic output from the Log Amplifier is full-wave rectified in the Synchronous Rectifier and is applied to the Function Switching Assembly (A8) for use in the Amplitude Display mode.

**4-12. Input Attenuator (A1/A2 R5, R6 Schematic No. 1).** Refer to Figure 7-1 and Schematic No. 1 for the following discussion.

4-13. The Input Attenuator serves as an input voltage divider and coupling network between the input connector and the input of the Preamplifier. With the front panel range switch set to the 0.2 mV to 2 V position, relay K1 is energized, K2 is deenergized and the input signal is coupled directly through C1 to the Preamplifier. When the 2 mV to 20 V range is selected, K1 is deenergized, K2 is energized and the input signal is attenuated by 20 dB by the 10:1 divider network consisting of R5, R6 and associated circuitry. The attenuator flatness and input shunt capacitance (< 30 pF) is maintained by compensating capacitors C2 and C3. The circuit configuration and capacitor values are such that the input capacitance remains constant regardless of the voltage range setting. Potentiometers A1R4 and A2R4 are adjusted for minimum phase shift between channels at 13 MHz and have little effect at lower frequencies.

**4-14. Preamplifier (A1/A2 Q3 through Q7 Schematic No. 1).** The Preamplifier is a low noise, high input impedance amplifier circuit which provides impedance conversion between the Input Attenuator and the input of the Log Amplifier. The Preamplifier is comprised of an input amplifier stage (Q3), a differential driver stage (Q4, Q5), a complementary-symmetry output stage (Q6, Q7) and an integrator (IC1). The input amplifier is a low noise field-effect transistor which, having a high input impedance, insures a minimum loading effect on the input signal. The input circuit is protected against overloads by limiting resistor R38. The complementary-symmetry output stage provides a low output impedance and supplies the power required to drive the following Log Amplifier stages. Overall gain, stability and linearity is maintained by negative feedback from the junction of R19 and R20 through the parallel network comprised of L1 and R22 to the source of FET Q3. Due to the parallel L/R network (L1, R22) in the feedback path, the gain of the preamplifier increases with frequency. At low frequencies, the reactance of L1 is very low, the feedback is nearly 100 % and the Preamplifier gain is approximately 1. At high frequencies the reactance of L1 increases, the feedback decreases and the gain approaches 1.1. The reason for this is to compensate for high frequency roll-off in the Log Amplifier and associated circuitry. Added stability in the Preamplifier is provided by dc feedback from the junction of R19 and R20 through integrator IC1 and the Input Attenuator network to the gate of Q3. The purpose of this feedback is to maintain 0 Vdc at the output of the Preamplifier.

**4-15. Overload Detector (A1/A2 Q8 through Q10 Schematic No. 1).** The Preamplifier output signal at the junction of R22 and R39 is rectified by CR5, filtered by C14 and applied to the base of Q8. When the dc level at the base of Q8 becomes more positive than 2.6 Vdc (2.2 V rms input), Q8 conducts, Q9 cuts off and Q10 is forward biased through R26 and R27. Transistor Q10 drives the corresponding overload indicator ($A_{OL}/B_{OL}$) on the Panel Meter.

**4-16. Log Amplifier (A3/A4 IC1 Schematic No. 1).** The Log Amplifier (IC1) is a hybrid circuit designed specifically for use in the Model 3575A. This circuit converts the input amplitude to a logarithmic value, furnishes a log output (IC1 pins 1, 5, and 9) for amplitude measurements and produces a limited output (IC1 pin 12) that is used for phase measurements. The major advantage of the Log Amplifier is that it produces usable outputs over a dynamic input range of 80 dB.

4-17. The output signal from the Preamplifier is applied to pins 20 and 22 of the Log Amplifier package. The input circuit in the Log Amplifier is protected by the diode-bridge limiting network comprised of A3CR1 through A3CR4. The dc operating point of the Log Amplifier is controlled by an external feedback loop between pins 14 and 21 of the package. The dc signal at pin 14 is filtered by a single-pole active network (A3IC2 and associated circuitry) and is fed back to pin 21. In order to obtain adequate filtering over the entire frequency spectrum, the filter response must be changed in accordance with the input frequency. This is accomplished by means of transistors A3Q1 through A3Q3 which are used to switch resistors A3R9, R11 and R13 in or out of the R/C filter network. The switching transistors are controlled by two lines, FR1 and FR2, from the front panel FREQUENCY RANGE switch. Note that the frequency range lines (FR1, FR2) are also applied to the bases of A3Q4, Q5 and Q6. These transistors are used to switch-in various values of capacitance (A3C7 through A3C9) at the limited output (pin 12) of the Log Amplifier. The purpose of this filtering is to minimize the high frequency noise coupled to the Level Translator and following Phase Detector circuitry.

**4-18. Level Translator (A3/A4 Q8, Q9 Schematic No. 1).** The limited output from pin 12 of the Log Amplifier is filtered and applied to the Level Translator circuit consisting of A3Q8 and A3Q9. The Level Translator is a differential amplifier which converts the level of the incoming signal to a level that is compatible with the emitter-coupled logic (ECL) used in the Phase Detector and associated circuitry. The resulting outputs are two square waves that are equal in amplitude and 180 degrees out of phase. The square-wave outputs from the Level Translator in each Input Channel are applied directly to the Phase Detector circuits which are discussed in Paragraph 4-21.

**4-19. Synchronous Rectifier and Summing Amplifier (A3/A4 IC4 through IC6 Schematic No. 1).** The log outputs from pins 1, 5 and 9 of the Log Amplifier are summed at the emitter of Q7. The logarithmic signal at the collector of Q7 is direct-coupled to two differential amplifiers. The differential amplifier in the upper portion of the schematic (IC4A) clips the applied signal and produces two square-wave outputs that are equal in amplitude and 180 degrees out of phase. The square waves remain at an essentially fixed amplitude over the entire dynamic range. The differential amplifier in the lower portion of the schematic (IC4B) produces two logarithmic outputs that are equal in amplitude and 180 degrees out of phase. All four of these preconditioned signals are applied to the Synchronous Rectifier, IC5. In the Synchronous Rectifier, the square-wave outputs from the limiting amplifier (IC4A) alternately gate-out positive going and negative going portions of the logarithmic signal from differential amplifier IC4B. This produces positive and negative full-wave rectified outputs which are filtered by C17 and C18 and combined in the Summing Amplifier (IC6) to produce a single dc output voltage that is logarithmically proportional to the amplitude of the input signal. This output is applied to the Panel Meter through the Function Switching Assembly (A8) and Output Filter (A9) in the Amplitude Display mode.

4-20. There are four adjustments in the Synchronous Rectifier portion of the Log Converter Assembly. The bias adjustment, A3R18 (emitter of Q7), is adjusted for 0 Vdc at the collector of Q7. Potentiometer A3R29 is used to balance the limiting amplifier (IC4A) to obtain optimum symmetry. Potentiometer R32 adjusts the gain of the Synchronous Rectifier (IC5) such that an amplitude change of 70 dB at the input produces a 70 dB change in the Log A (A3) or Log B (A4) amplitude reading. The log offset adjustment (R50) in the Summing Amplifier circuit is adjusted for a panel meter reading of +6 dBV with a 2 V rms signal applied to the input.

## 4-21. Phase Detector (A5 Schematic No. 2).

4-22. Refer to the Functional Block Diagram (Figure 7-1) and Schematic No. 2 for the following discussion.

4-23. The square-wave outputs from the Level Translator in each input channel are applied to the Limiter circuit in the Phase Detector. The Limiter circuit is comprised of two differential amplifiers, IC1A and IC1C, which are connected in Schmitt Trigger configurations. These differential amplifiers detect the axis crossing points of the applied signals and produce square-wave outputs that are limited to approximately 1 V p-p. The outputs of the Limiter are A which is in phase with the signal applied to channel A, B which is in phase with the signal applied to channel B and B' which is 180 degrees out of phase with the signal applied to channel B. Note that the B signal from IC1C is applied to a third differential amplifier, IC1B. The purpose of IC1B is to provide a gate delay equal to that of the A channel Exclusive OR gate (IC2C) so that both signals applied to the "Q" Phase Detector (IC2B) encounter one gate delay.

4-24. The A and B' outputs from the Limiter are applied to the A channel and B channel Exclusive OR gates (A5IC2C, IC2D). The purpose of the Exclusive OR gates is to provide inverted or non-inverted outputs in response to dc logic levels. Note that the signal from channel A is applied to one input of the A channel Exclusive OR gate while a logic level from the front panel PHASE REFERENCE switch is applied to the other input. Whenever *both* inputs are high (1) or low (0), the output is low. If only one input is high, the output is high. For example, with the PHASE REFERENCE switch in the "A" position, the logic input to the A channel Exclusive OR gate is high. The output of the gate is, therefore, low when the signal input is high making it 180 degrees out of phase with the signal input. With the PHASE REFERENCE switch in the "- A" position, the logic input is low and the output is in phase with the signal input. The B channel Exclusive OR gate operates in the same manner but is controlled by the logic output from the "Q" Phase Detector (Paragraph 4-30).

4-25. The outputs of the A channel and B channel Exclusive OR gates are applied directly to two OR/NOR

gates (A5IC3A, IC3B). Each OR/NOR gate splits the phase of the incoming signal and provides two outputs that are equal in amplitude and 180 degrees out of phase. These outputs are used to trigger the two J-K flip flops (IC7A, IC7B) that serve as phase detectors and are also applied to the Error Correction Circuits (IC4 through IC6) which are discussed in Paragraph 4-55. The upper J-K flip flop, IC7A, is "set" by a positive transition on A at the "J" input and "reset" by a positive transition on B' (same as a negative transition on B) at the "K" input. The lower J-K flip flop, IC7B, is "set" by a positive transition A' (same as a negative transition on A) at the "J" input and "reset" by a positive transition on B at the "K" input. The outputs of the two flip flops, designated P1, P1', P2 and P2', respectively, are applied to differential amplifiers IC8B and IC8A. The differential amplifiers gate on and gate off two constant current sources (also designated P1 and P2) which supply current to the following Buffer/Integrator stage (IC9). The Buffer/Integrator serves as an impedance converter, an inverter and a high frequency integrator (note that A5C1 is only 0.1 $\mu$F). The average value of the pulse train at the output of the Buffer/Integrator is proportional to the phase difference between the two input signals, A and B.

4-26. When gated on, the Current Sources, P1 and P2, each supply 1 mA to the Buffer/Integrator. Due to the 1804 ohm feedback resistance (A5R33) of the Buffer/Integrator, a 1 mA input current produces an output of - 1.8 volts. With both current sources on, the sum of the input currents in 2 mA and the resulting output is - 3.6 volts.

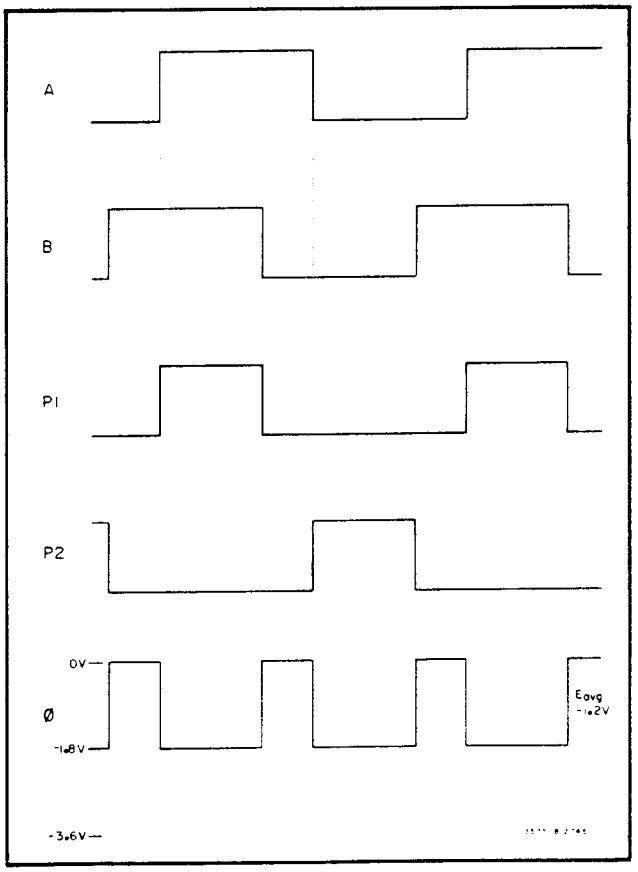



**Figure 4-2. Phase Difference + 60 Degrees.**

4-27. Figure 4-2 shows the two limited input signals (A and B), the outputs of the two J-K flip flops (P1 and P2) and the resulting pulse train (Ø) at the output of the Buffer/Integrator. In Figure 4-2, the phase difference between A and B is + 60 degrees (B leads A) and the average value of the pulse train at the output of the Buffer/Integrator is - 1.2 volts.

4-28. Figure 4-3 shows the Phase Detector output voltage (integrated) vs. phase from - 90 degrees to + 90 degrees. Note that the Phase Detector output alone does not provide a valid phase reading. For example, with an applied phase difference of + 60 degrees, the Phase Detector output is

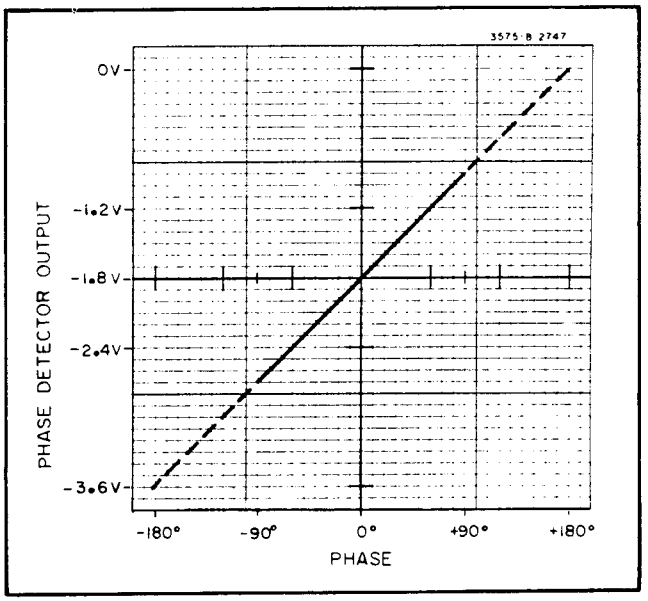



**Figure 4-3. Phase Detector Output.**

- 1.2 V which, if applied to the Panel Meter, would produce a phase reading of - 120 degrees. A correct phase reading can be obtained, however, by offsetting the Buffer/Integrator output by + 1.8 Vdc. When required, dc offsets are provided by the X and Y Current Sinks at the input of the Buffer/Integrator. These Current Sinks are controlled by the Phase Control Logic (A11) which senses the Phase Detector output and, in turn, gates the Current Sinks on or off to maintain a correct phase reading. When only one of the Current Sinks is gated on, the resulting offset at the output of the Buffer/Integrator is + 1.8 Vdc. When both Current Sinks are on, the offset is + 3.6 Vdc. The Phase Detector output, when combined with the offsets introduced by the X and Y Current Sinks will yield a correct phase reading.

4-29. Before continuing with the overall phase measuring scheme, one important factor must be considered. As the input frequency increases or as the phase magnitude approaches 180 degrees, the time between the transitions

that trigger the J-K flip flops decreases until a point is reached where the transition regions overlap. In the case where A and B are 180 degrees out of phase, A goes high at the same time B goes low; thus, A and B' occur simultaneously. Since the P1 flip flop (IC7A) is "set" by A and "reset" by B', it could not respond properly. The same is true for the P2 flip flop since it is controlled by the other two transitions, A' and B. Due to the fixed response time of the J-K flip flops, they will respond to a maximum phase difference of 150 degrees at 10 MHz and approximately 175 degrees at 1 MHz. In order to accurately measure phase in this region, it is necessary to invert the signal on one channel so that the phase difference is within the operating range of the J-K flip flops. This is accomplished by means of the "Q" Phase Detector which senses the phase magnitude and inverts the output of the B channel Exclusive OR gate when the phase magnitude is greater than 90 degrees.

## 4-30. "Q" Phase Detector (Schematic No's. 2, 3 and 4).

4-31. Refer to the Functional Block Diagram (Figure 7-1) for the following discussion.

4-32. The "Q" Phase Detector is comprised of one Exclusive OR gate, a Differential Amplifier, a Constant Current Source and a Buffer/Integrator. The output of the Buffer/Integrator is filtered by the Phase Control Filter (A7) and applied to a Threshold Detector. The Threshold Detector provides a high (1) or low (0) output depending on the magnitude of the phase difference between the two input signals. When the phase magnitude is less than 90 degrees, the Threshold Detector output (designated "Q") is high; when the phase magnitude is greater than 90 degrees, the output is low. The "Q" output is applied to the B channel Exclusive OR gate where it is used to invert the Exclusive OR output when the phase magnitude is greater than 90 degrees. The "Q" output is also applied to the Phase Control Logic to enable logic circuits that control the X and Y current sinks.

4-33. The two signals applied to the Exclusive OR gate in the "Q" Phase Detector are A' and $B_d$'. The output of the Exclusive OR gate (designated P3) is high (1) when A' and $B_d$' are in opposite states (one high, one low) and low (0) when they are in identical states (both high, both low). The width of the output pulses, therefore, represents the magnitude of the phase difference between the two signals. The Exclusive OR output is applied to a Differential Amplifier which provides the voltage swing required to gate on and gate off the Constant Current Source. The pulsating dc from the Constant Current Source is applied to the Buffer/Integrator which, like the Buffer/Integrator in the Phase Detector, serves as an impedance converter, an inverter and high frequency integrator. The output of the Buffer/Integrator is applied to the Phase Control Filter which detects the average value of the pulse train and provides a dc output voltage proportional to phase magnitude. Figure 4-4 is a graph showing the voltage level vs. phase at the output of the Phase Control Filter. This voltage is applied to a Threshold Detector (A11IC9) which

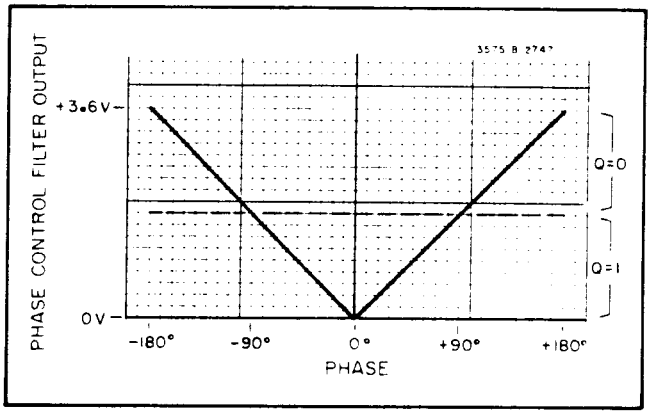



**Figure 4-4. Phase Control Filter Output.**

provides a logical "1" output when the phase magnitude is less than 90 degrees and a "0" output when the phase magnitude is greater than 90 degrees.

**4-34. Phase Control Filter (A7 Schematic No. 4).** The Phase Control Filter is a 4-pole low-pass filter network that is controlled by the front panel FREQUENCY RANGE switch. The purpose of the filter is to integrate the pulsating dc output from the "Q" Phase Detector and control the transient response time of the phase control circuits.

4-35. The basic filter configuration is shown in Figure 4-5. The filter is comprised of two active sections (IC1, IC2) and an impedance converter (IC3). Each of the two sections contains an operational amplifier which serves as a voltage-controlled voltage source. Filter response is determined by the R/C elements in the input and feedback networks of the operational amplifiers. The resistive elements remain constant while the appropriate values of capacitance are selected by means of FET switches, A7Q1 through A7Q12. The FET switches are controlled by three lines (F, M and S) which, in conjunction with switching transistors A7Q13 through A7Q15, are controlled by two lines (FR1 and FR2) from the front panel FREQUENCY RANGE switch. Table 4-1 is a truth table which indicates the conditions of the FR1 and FR2 control lines, the F, M and S control lines

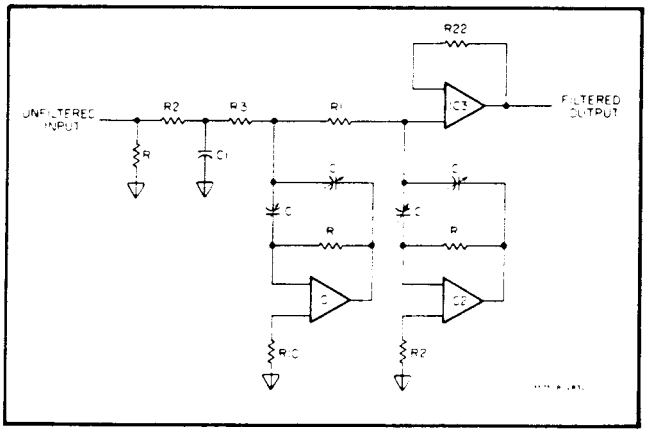



**Figure 4-5. Basic Filter Configuration.**

Table 4-1. Filter Control Logic.

| Range | FR1 | FR2 | F | M | S | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 - 1 K | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 |
| 10 - 100 K | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 100 - 1 M | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 1 K - 13 M | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 = -4.7 V<br>1 = +5 V | | 0 = -12 V<br>1 = +5 V | | | 1 = Conducting<br>0 = Cut Off | | | | | | | | | | | |

and the various FET switches on each of the four frequency range settings. Note that the F, M and S control lines are also applied to the Output Filter(s) (A9/A10) through A7 pins W, X and V.

**4-36. Operational Review.** As indicated in Paragraph 4-29, the flip flops in the Phase Detector cannot respond properly when the phase magnitude approaches 180 degrees. The inoperative region is avoided, however, by inverting the signal from channel B when the phase magnitude is greater than 90 degrees. This is accomplished by means of the "Q" Phase Detector which controls the phase of the signal at the output of the B channel Exclusive OR gate. When the phase magnitude is less than 90 degrees, Q is in a high (1) state. When Q is high, the output of the B channel Exclusive OR gate is 180 degrees out of phase with the input (B') and is in phase with the signal applied to channel B. When the phase magnitude is greater than 90 degrees, Q goes low (0) and the output of the B channel Exclusive OR gate is inverted. The phase difference applied to the J-K flip flops is, therefore, always within the range of - 90 degrees to + 90 degrees. The Phase Detector output, along with Q from the "Q" Phase Detector, is applied to the Phase Control Logic which, in response to these inputs, gates the X and Y Current Sinks on or off to produce a correct phase reading.

## 4-37. Phase Control Logic (A11 Schematic No. 3).

4-38. Refer to the Phase Control Logic Functional Block Diagram (Figure 4-6) for the following discussion.

4-39. With the front panel DISPLAY switch in the PHASE position, the integrated output from the Phase Detectors is filtered (Output Filter Assy., A9) and applied to the Panel Meter and the Phase Control Logic (PCL). This voltage ranges from approximately - 1.92 Vdc to + 1.92 Vdc depending on the phase magnitude, phase polarity and the condition of the X and Y current sinks. The only other input to the Phase Control Logic is Q (from the "Q" Phase Detector) which indicates that the phase magnitude is less than or greater than 90 degrees. The "Q" input is initially inverted by IC4A to obtain Q' which is high (1) when the phase magnitude is greater than 90 degrees and low (0) when the phase magnitude is less than 90 degrees.

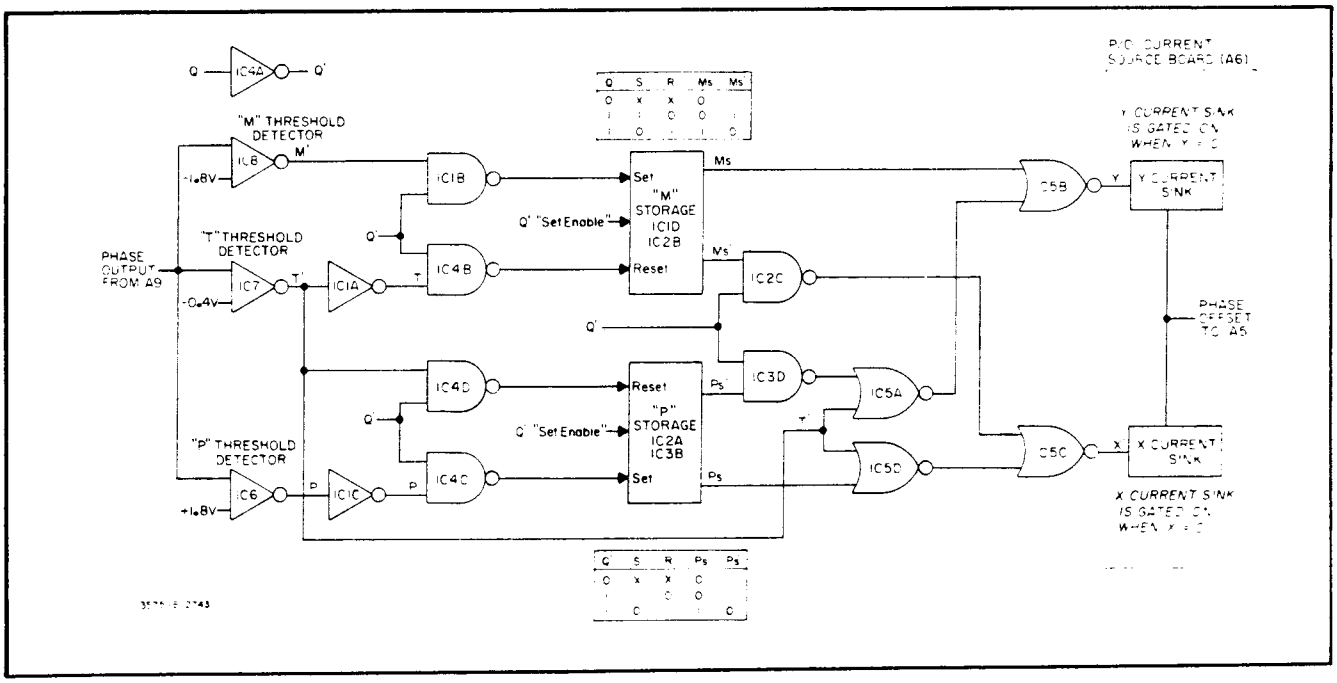



Figure 4-6. Phase Control Logic Functional Block Diagram.

4-40. The filtered dc output voltage from the Phase Detectors is applied directly to three threshold detectors, IC6 through IC8. The outputs of these three threshold detectors, designated M', T' and P' are listed and defined in Table 4-2. These threshold detector outputs are used to control two Set/Reset flip flops which serve as storage elements. The outputs of the two storage elements (designated $M_S$, $M_S$', $P_S$ and $P_S$') along with T' and Q' are further used to control the X and Y current sinks.

**Table 4-2. Threshold Detector Outputs.**

| Threshold Outputs | Definition |
|---|---|
| M' | Goes high (1) when phase output voltage becomes more negative than - 1.92 Vdc; goes low (0) as phase output voltage becomes more positive than - 1.7 Vdc*. |
| T' | Goes high when phase output voltage becomes more negative than - 0.4 Vdc; goes low as phase output voltage becomes more positive than - 0.2 Vdc*. |
| P' | Goes low when phase output voltage becomes more positive than + 1.92 Vdc; goes high when phase output voltage becomes more negative than + 1.7 Vdc*. |

* In each case, the positive and negative thresholds differ by approximately 0.2 Vdc due to hysteresis.

4-41. Before proceeding with the functional description, it would be well to review the operation of NAND gates and NOR gates which are used extensively in the Phase Control Logic circuitry. These gates are shown in Figure 4-7 along with their respective truth tables.

4-42. In most cases, it is easier to understand logic if it is expressed in terms of AND/OR functions rather than NAND/NOR functions. For example, the X current sink

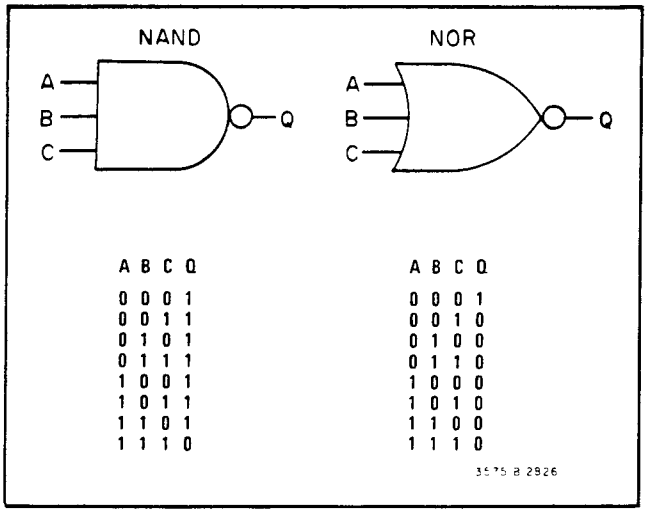



**Figure 4-7. Logic Gates.**

(Figure 4-6) is gated on when the output of IC5C (X') is low. This is controlled by the logic equation $X' = \overline{Q + M_S + T \cdot P_S'}$. Since the X current sink is gated on when X' = 0, it can be inversely stated that the X current sink is gated on when X = 1; where: $X = Q + M_S + T \cdot P_S'$. The X current sink is then gated on when Q = 1 OR when $M_S$ = 1 OR when T AND $P_S'$ = 1. Likewise, the Y current sink is gated on when the output of IC5B (Y') is low; where: $Y' = \overline{M_S + Q' \cdot T \cdot P_S'}$. Inversely, $Y = M_S + Q' \cdot T \cdot P_S'$ and the Y current sink is gated on when $M_S$ = 1 OR when Q' AND T AND $P_S'$ = 1.

4-43. When the phase magnitude is less than 90 degrees, the "M" and "P" storage elements are held in the reset condition by Q' which is in a low state. With both flip flops in the reset condition, $M_S$ = 0, $M_S'$ = 1, $P_S$ = 0 and $P_S'$ = 1. Since the Q' input to NAND gate IC2C is low, the output of this gate is high. This causes the output of NOR gate IC5C (X') to go low and the X current sink to conduct. Whenever Q' is low, the output of NAND gate IC3D is high and the output of NOR gate IC5A is low. Since $M_S$ and the output of IC5A are *both* low, the output of IC5B (Y') is high causing the Y current sink to cut off. Thus, when the phase magnitude is less than 90 degrees (Q = 1), the X current sink is on and the Y current sink is off.

4-44. With the phase difference of + 120 degrees applied to the inputs, Q goes low, B channel is inverted, and the phase difference applied to the Phase Detectors is - 60 degrees. In this case, both current sinks are initially turned off and the output of the Phase Detectors drops toward - 2.4 Vdc. This condition is sensed by the "M" threshold detector causing M' to go high. Since M' and Q' are both high, a set command is applied to the "M" storage element causing $M_S$ to go high. When $M_S$ = 1, both current sinks are gated on and the phase detector output is offset by + 3.6 Vdc (- 2.4 V + 3.6 V = + 1.2 Vdc). During the transition, the phase output voltage becomes more positive than - 1.6 Vdc, M' goes low and $M_S$ is retained by the "M" storage element. As the voltage rises above - 0.2 Vdc, however, T' goes low, T goes high and the "M" storage element is reset. The X current sink remains on because T' and $P_S$ are both low causing the output of IC5D to go high and the output of IC5C (X') to go low. The Y current sink remains on because Q' and $P_S'$ are both high causing the output of IC3D to go low which, along with T', causes the output of IC5A to go high and the output of IC5B (Y') to go low. A correct phase reading of + 120 degrees (+ 1.2 Vdc) is, therefore, maintained by the X and Y current sinks. The Phase Control Logic operates in the same manner for all positive phase differences greater than + 90 degrees and less than + 192 degrees.

4-45. If the phase reading exceeds + 192 degrees (+ 1.92 Vdc), the output of the "P" threshold detector goes low (P = 1, Q' = 1) and a set command is applied to the "P" storage element. This causes both current sinks to cut-off and the phase reading becomes - 168 degrees (- 1.68 Vdc). As the phase output voltage crosses through - 0.4 Vdc in a negative direction, the "P" storage element is reset by T'

which goes to a high (1) state. The X current sink remains off because Q', T' and $M_S$' are all high. The Y current sink remains off because $M_S = 0$ and T' = 1.

4-46. With a phase difference of - 120 degrees applied to the inputs, Q goes low, B channel is inverted and the phase difference applied to the phase detectors is +60 degrees. The resulting phase detector output is - 1.2 Vdc. In this case, the X current sink is cut off because Q' = 1 (Q = 0), $M_S = 0$ and T' = 1 (T = 0). The Y current sink is cut off because $M_S = 0$ and T' = 1 (T = 0). The result is a correct phase reading with no offsets required. The Phase Control Logic operates in the same manner for all negative phase differences greater than - 90 degrees and less than - 192 degrees.

4-47. If the phase reading exceeds - 192 degrees (- 1.92 Vdc). M' goes high and a set command is applied to the "M" storage element. Both current sinks are then gated on (as outlined in Paragraph 4-44) and the phase reading changes from - 192 degrees to + 168 degrees. This is similar to the + 192 degree condition where both current sinks are gated off and the reading is converted to - 168 degrees. Having the switching points at ± 192 degrees rather than ± 180 degrees provides a ± 12 degree overrange capability which prevents the Phase Feeding from oscillating between ± 180 degrees due to the overshoot in the Output Filter (A9 or A10).

### 4-48. Effects of Harmonic Distortion on Phase.

4-49. In the 3575A, phase difference is measured between the axis crossing points of the two input signals. If an applied signal contains harmonics of the fundamental frequency, the axis crossing points will change depending on the magnitude, phase and order of the harmonics. Harmonics that are in phase with the fundamental frequency do not change the axis crossing points and, therefore, do not affect the accuracy of phase readings. Harmonics that are out of phase with the fundamental, however, do change the axis crossing points and, in some cases, produce errors in the phase reading.

4-50. Odd harmonics that are out of phase with the fundamental tend to produce a symmetrical waveform that is completely shifted in phase. This type of error is difficult to eliminate without the benefit of selective filtering. Since the 3575A is a broadband instrument, high levels of odd, out-of-phase harmonics can produce phase offsets. Figure 3-7 (Section III) is a graph which shows the worst-case error produced by odd, out-of-phase harmonics. The worst-case condition occurs when the harmonics are shifted 90 degrees with respect to the fundamental. As indicated in the graph, the error is relatively insignificant (0.57 degrees) when the total odd harmonic distortion is more than 40 dB below the fundamental.

4-51. Even harmonics that are out of phase with the fundamental change the axis crossing points but, unlike odd harmonics, produce an unsymmetrical waveform. This makes it possible to cancel the effects of even harmonic distortion in the 3575A by the use of two phase detectors which operate 180 degrees out of phase. This technique is illustrated in Figures 4-8 and 4-9. In Figure 4-8, the phase detector outputs, P1 and P2, are controlled by transitions that occur at the axis crossing points of the applied signals, A and B. The P1 phase detector is gated on by a positive transition on A and off by a negative transition on B; P2 is gated on by a negative transition on A and off by a positive transition on B. The phase detector outputs are summed (and inverted) to produce a single pulse train (Ø) with an average value that is proportional to the phase difference between A and B. The two input signals in Figure 4-8 are in phase and the average value of the output pulse train is equal to the peak voltage introduced by P1 or P2 which, in this case, is - 1.8 V.

4-52. Figure 4-9 is identical to Figure 4-8 except the signal applied to channel B contains a 10 % second harmonic that is out of phase with the fundamental. The combined average output of the two phase detectors is still equal to - 1.8 V because the distorted signal on B produces equal and opposite errors on P1 and P2 thereby cancelling the effects of the distortion.

### 4-53. Error Correction Scheme.

4-54. The 3575A uses logic circuitry (A5IC4 through IC6, Schematic No. 2) in a unique error correction scheme to

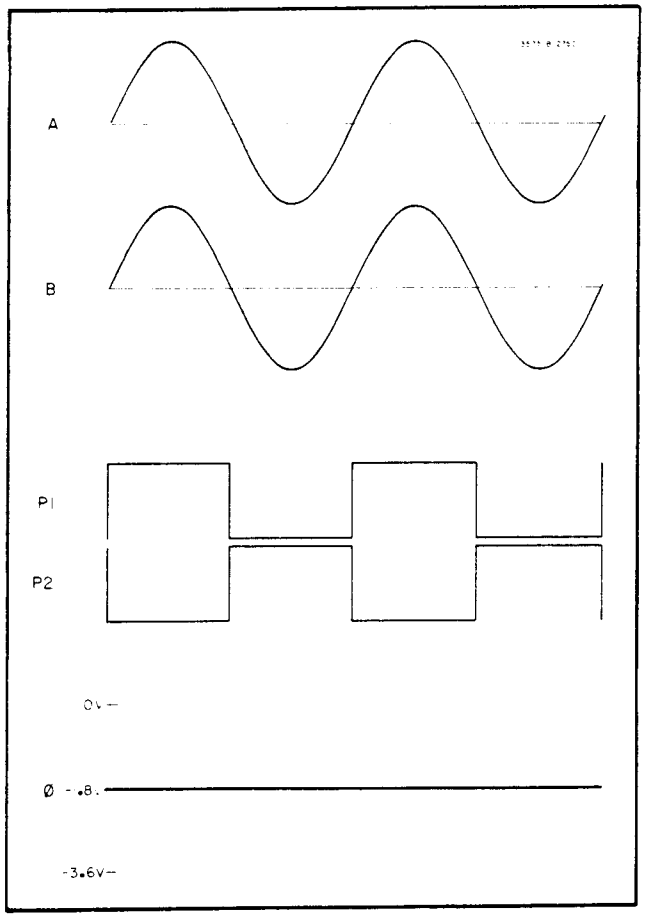



Figure 4-8. A and B In Phase - No Distortion.

minimize the effects of noise on phase readings. The following paragraphs briefly describe how noise can introduce errors and how these errors are corrected.

4-55. Because the 3575A is a broadband, wide range instrument, it is capable of responding to high frequency noise that can "false trigger" the J-K flip flops in the Phase Detector. False triggering is where the J-K flip flops are improperly "set" or "reset" by noise transitions that occur near the axis crossing points of the applied signals. This is illustrated in Figures 4-10 and 4-11. Figure 4-10 shows the outputs of the two phase detectors P1 and P2 produced by noise-free signals, A and B. Figure 4-11 shows the same phase relationship as Figure 4-10 however the signal on channel A contains a number of positive and negative transitions produced by noise. The J-K flip flops respond to these transitions causing a very significant error (designated by shaded areas) in the phase reading. Note that P2 is initially set high by a negative noise transition on A (same as A') and is not reset until B goes high 250 degrees later. Also note that all four signals, A, B, P1 and P2 are high immediately following the noise pulses on the leading edge of A. During normal phase measurements these four signals should never be high at the same time. This condition is, therefore, an error state which can be defined by the logic equation A·B·P1·P2 = 1 and further detected and corrected

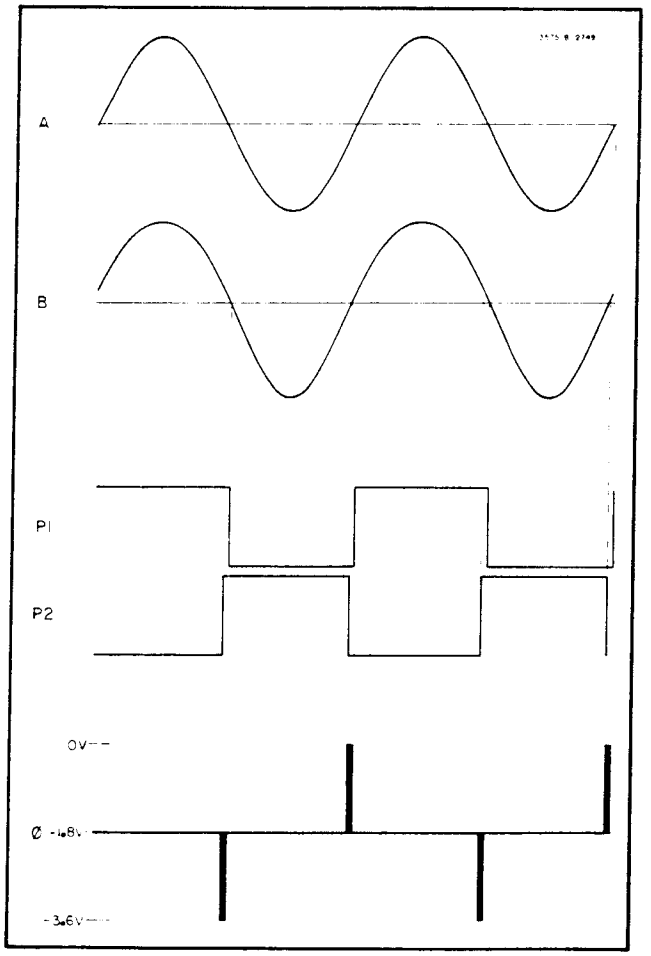



Figure 4-9. Even Harmonics Cancelled.

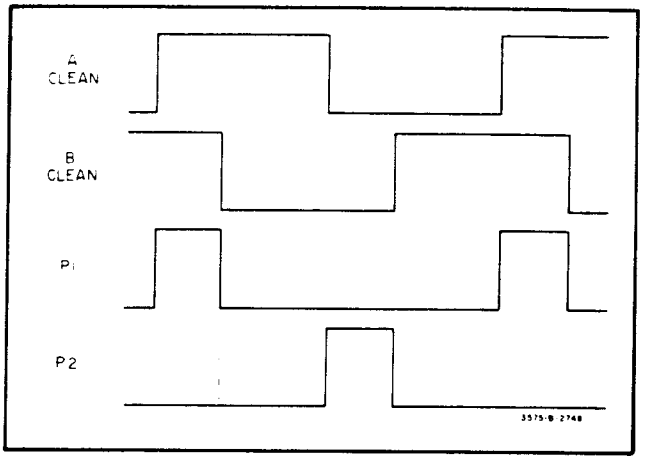



Figure 4-10. A and B Clean - No Error.

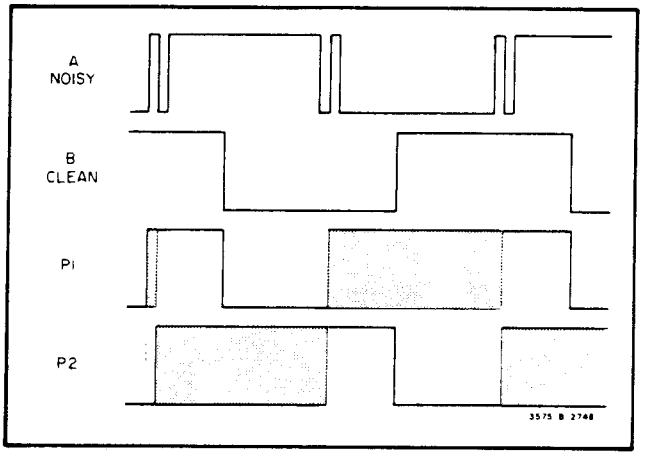



Figure 4-11. Large Error Produced by Noise.

using logic circuitry. This method of error correction is used in the 3575A and is accomplished by means of logic circuitry (A5IC4 through IC6) on the Phase Detector Assembly. The four primary signals (A, B, P1 and P2) and their opposites (A', B', P1' and P2') are applied to the error correction circuits. The error correction circuits sense any of the eight error states listed in Table 4-3 and "set" or "reset" the appropriate flip flop to correct the error.

Table 4-3. Error Correction Equations.

| No. | Equation | Function |
|---|---|---|
| 1 | A·B·P 1·P 2 | Reset P 2 low |
| 2 | A'·B'·P 1·P 2 | Reset P 1 low |
| 3 | A·B·P 1'·P 2' | Set P 1 high |
| 4 | A'·B'·P 1'·P 2 | Set P 2 high |
| 5 | A'·B·P 1'·P 2 | Reset P 2 low |
| 6 | A·B'·P 1·P 2' | Reset P 1 low |
| 7 | A·B'·P 1'·P 2 | Set P 1 high |
| 8 | A'·B·P 1·P 2' | Set P 2 high |

4-56. Since error states must be present for a short time before they can be detected and corrected, they can still affect the accuracy of phase readings. Due to the error correction scheme, however, worst-case errors are limited to

a few degrees. This is a vast improvement over conventional phase meters that give totally erroneous readings in the presence of noise. For further information concerning the effects of noise on 3575A phase readings, refer to Paragraph 3-54.

## 4-57. Function Switching Circuits (A8 Schematic No. 5).

4-58. The Function Switching Assembly (A8) is comprised of four individual sections. Each section performs a particular switching or logic function in response to the front panel control settings.

**4-59. Compensating Circuits (A8IC1, IC2, Q1 through Q6).** The logarithmic outputs from the Synchronous Rectifiers in channels A and B are applied to operational amplifiers A8IC2 and A8IC1, respectively. Note that the gain of these operational amplifiers is controlled by thermistors R56 and R57 in the feedback networks. The purpose of the thermistors is to change the gain of the operational amplifiers to compensate for slight gain variations that occur in the Log Amplifiers due to temperature. Under normal conditions, the gain of IC1 and IC2 is between 1 and 1.1.

4-60. Transistors Q1 through Q3 and Q4 through Q6 at the outputs of IC1 and IC2 are controlled by the corresponding voltage range switch on the front panel. When the channel B range switch is set to the 2 mV to 20 V position, Q1 and Q3 are conducting and Q2 is cut off. When conducting, Q1 supplies a 1 mA current which produces a 200 mVdc drop across R12. This offsets the Log B amplitude reading by +20 dB to compensate for the 20 dB signal attenuation introduced by the Input Attenuator. When the 0.2 mV to 2 V range is selected, Q1 and Q3 are cut off and Q2 is switched on. Since the Input Attenuator does not attenuate the signal on the lower range, an offset is not required. The purpose of Q2 is to attenuate the signal slightly to maintain equal loading on both ranges. Transistors Q4 through Q6 at the output of IC2 operate in the same manner to correct the Log A amplitude reading.

**4-61. Amplitude Summing and Function Switching Circuits (A8Q7 through Q14, IC3).** The outputs of A8IC1 and A8IC2 are applied directly to the function switching circuits consisting of A8Q7 through A8Q14. This circuitry is controlled by two lines, $A_F$ (A8 pins 8 and J) and $B_F$ (A8 pin 9 and K) which are connected to the front panel AMPLITUDE FUNCTION switch through the Interface Substitution Board (A16A) or the Interface Board (A16B - Option 002, 003).

4-62. Table 4-4 is a truth table which indicates the condition of the $A_F$ and $B_F$ control lines and the resulting states of the various switching transistors for each of the three amplitude functions. When Log A or Log B is selected, the summing amplifier (IC3) is operated with one input referenced to circuit ground through A8R47 and junction FET Q14. Since R47 and feedback resistor R46 are of equal value, the closed-loop gain of the summing amplifier is two (from the + input, pin 3). When Log A is selected, the signal from IC2 is coupled through FET Q10 and R31 to pin 3 of IC3. When Log B is selected, the signal from IC1 is coupled through Q8 and R29 to pin 3 of IC3. Note that the signal at the junction of R29 and R31 is divided by two due to the series resistance to ground provided by R32. Since the gain of the summing amplifier is two, the amplitude of the output signal (IC3 pin 6) is equal to that of the Log A or Log B input from IC1 or IC2.

4-63. When Log B/A is selected, Q10 and Q14 are cut off and Q8 and Q11 are switched on. The Log A signal from IC2 is then applied to pin 2 of IC3 through Q11 and R47 and the Log B signal is applied to pin 3 of IC3 through Q8 and R29. This makes the output of IC3 equal to the difference between the Log A and Log B inputs e.g., Log B minus Log A = Log B/A.

**4-64. Display Switching (A8Q15 through Q18).** The display switching circuit consisting of A8Q15 through Q18 is controlled by a single line, $C_F$ (A8 pins 10 and L) which is connected to the front panel DISPLAY switch through the Interface Substitution Board, A16A. When AMPLITUDE display is selected, circuit ground is applied to the $C_F$ control line causing Q15 and Q16 to conduct and Q17 and Q18 to cut off. The signal at the output of summing amplifier IC3 is then coupled through Q16 and out A8 pin U to the Output Filter Assembly. When PHASE display is selected, + 5 Vdc is applied to $C_F$, Q15 and Q16 are cut off and Q17 and Q18 are switched on. The dc output from the Phase Detector is then coupled from A8 pin V through Q18 and out A8 pin U to the Output Filter.

**Table 4-4. Amplitude Function Switching.**

| Amplitude Function | $A_F$ | $B_F$ | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 | Q14 | Q19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Log A | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| Log B | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Log B/A | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |

Control Lines:

1 = + 5 Vdc
0 = GND

Transistors:

1 = conducting
0 = cut off

**4-65. Annunciator Logic (A8IC4 through IC6).** The fourth section of the Function Switching Assembly is the annunciator logic circuitry, A8IC4 through IC6. This circuit receives inputs from the $A_F$, $B_F$ and $C_F$ control lines and two additional inputs from the overload detectors on the Preamplifier Assemblies, A1 and A2. The purpose of the annunciator logic is to control the overload indicators and the various function indicators that appear on the Panel Meter display.

## 4-66. Output Filter (A9/A10 Schematic No. 6).

4-67. The Output Filter is a 4-pole low pass filter network controlled by the front panel FREQUENCY RANGE switch. The purpose of the filter is to integrate the amplitude or phase information before it is applied to the Panel Meter and ANALOG OUTPUT. The filter response is controlled by three lines, F, M and S which come from the Phase Control Filter, A7. The Output Filter network is identical to the Phase Control Filter network which is discussed in Paragraph 4-34.

4-68. It should be noted that the standard Model 3575A which has a single panel meter requires only one Output Filter. This filter is designated A9. Instruments that are equipped with dual panel meters (Options 001--003) require a separate Output Filter for each panel meter and, therefore, contain both A9 and A10 which are identical. Since the dual panel meter options are field installable, the standard Model 3575A has a vacant board slot and connector to permit the addition of A10.

## 4-69. Digital Panel Meter.

4-70. Refer to the Panel Meter Block Diagram (Figures 4-12) and Schematic No. 7 for the following discussion.

4-71. The Digital Panel Meter is an analog-to-digital converter. It is a self-contained dc digital voltmeter which measures voltages between ± 1.999 V dc. The Panel Meter reading in dB, dBV or degrees corresponds with the applied dc voltage, (e.g. an input of - 1.800 V dc will produce a reading of - 180.0 degrees; an input of + 200 mV dc will produce a reading of + 20.0 degrees or + 20.0 dBV). Analog input voltages greater than 1.999 V cause the display to blink, indicating overrange.

4-72. The five major sections of the Panel Meter are the Analog section, the Control Logic, the Counter, the Data Multiplexer and the Display. The analog input from the instrument is switched through a buffer amplifier to the Analog section where a balance disruption and restoration takes place in response to sequential instructions from the Control Logic, The Counter section maintains a count corresponding to the analog input voltage. The Data Multiplexer converts the count to 8-4-2-1 BCD information which is synchronized with the digit and polarity strobe and applied to the Display.

4-73. A measurement cycle consists of two intervals: one interval for the auto-zero and one for the digital conversion of the analog signal. The clock frequency is divided into two sampling intervals, totaling 6144 pulses and made up of 4096 pulses for the measure interval, and 2048 pulses for the auto-zero interval.

4-74. The auto-zero interval begins every measurement cycle by allowing the effects of temperature and drift to be impressed on the storage capacitor (C2). This stored voltage is introduced during the measure interval and counteracts the thermal offset, thus the drift of the Analog section is constantly monitored.

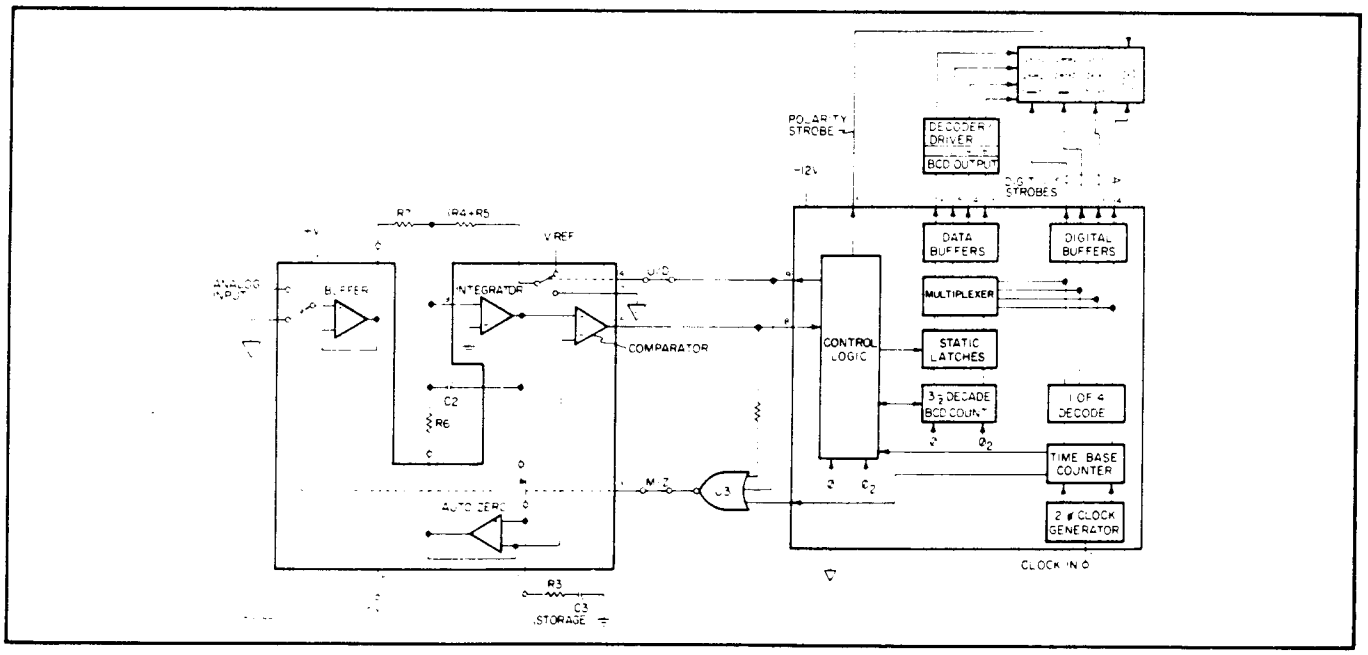



Figure 4-12. Panel Meter Block Diagram.

4-75. At the start of the measure interval, the input of the Analog section is switched to the analog voltage supplied by the instrument. The additional current disrupts the balance achieved in the auto-zero interval, driving the integrator output away from the auto-zero equalibrium voltage. The Comparator senses this deviation and transmits the information to the Control Logic, which then responds with the proper logic to reestablish the zero level. The time required for the Analog output to return to zero is accumulated in the Counter and corresponds to the analog input.

4-76. At the end of the measure interval, the count is transmitted to the Data Multiplexer where it is converted to 8-4-2-1 BCD information, synchronized with the digit and polarity strobe and applied to the Display. Polarity information is also transmitted via the BCD output. When the measure interval is complete and the digits displayed, a new measurement cycle begins.

4-77. The Digital Panel Meter is built around a 3½ digit analog to digital converter set, A22U1 and A22U2. A22U1 is an analog processor which contains a bipolar comparator, a bipolar integrating amplifier, two MOS-FET input unity gain amplifiers, several P-channel enhancement mode analog switches and the necessary level shifting drivers to allow the analog and digital processors to be directly interfaced. A22U2 is a synchronous digital processor that combines the counting, storage and data multiplexing functions with the random logic necessary to control the functions of the analog processor. The digital processor contains seventeen statis latches for storing the 3½ digits of BCD data, overrange, underrange and polarity information. Nine push-pull output buffers provide the sign, digit strobe and multiplexed BCD data outputs. The Digital Panel Meter provides a full scale display for an analog input voltage of 1.999 V. This full scale of the Panel Meter is not to be confused with instrument full scale indications.

**4-78. Measurement Cycle.** The 3½ digit analog-to-digital converter set, A22U1 and A22U2, converts the analog input voltage to a corresponding 8-4-2-1 BCD output once each measurement cycle. Polarity, overrange and underrange information is also determined once each measurement cycle. The measurement cycle is controlled by the time base counter located in A22U2. The time base counter divides the clock frequency generated by A22U1 into sampling intervals of 6144 pulses which constitute one measurement cycle. Each measurement cycle consists of two-intervals—an auto-zero interval and a measure interval. Of the 6144 pulse measurement cycle, 2048 pulses comprise the auto-zero interval and 4096 pulses comprise the measure interval.

**4-79. Auto-Zero Interval.** The purpose of the auto-zero interval is to establish an equilibrium voltage which represents the offset introduced by the drift of the analog section. Refer to Figure 4-12 and 4-13 for this discussion.

4-80. The auto-zero and measure intervals are controlled by the Measure/Zero logic (M/Z) originating from the time base counter in A22U2. A low logic level on the M/Z line switches the input of the buffer amplifier to ground. When the M/Z logic, the Up/Down logic (U/D) and the comparator output are all low, the Override section provides a high output. This turns off A22Q2 and applies - 12 V to the gate of A22Q1. A closed-loop system of integrator and auto-zero amplifier is formed by the operation of A22Q1. The delay interval, or override period, in initiating the closed-loop system, allows the integrator output to return to the equilibrium voltage of the previous measurement cycle.

4-81. The input of the auto-zero closed loop system is the summing node at the negative port of the integrator in A14U1. Three currents are summed at this node. The buffer amplifier in conjunction with A22R7 forms a voltage-to-current converter which supplies current to the integrator input summing node. Voltage-to-current conversion is also performed by the auto-zero amplifier in conjunction with A22R6 and the reference voltage in conjunction with A22R4 and A22R5. These are the other two currents summed at the summing node. Since the buffer amplifier input is grounded, the current supplied to the integrator summing node is minor. The auto-zero amplifier current and the reference current are the major currents flowing into the integrator summing node. The reference current is pulsed at a 50% duty cycle (4 clock cycles on and 4 clock cycles off) by the U/D logic generated in the control logic portion of A22U2. The output of the integrator in the closed-loop system seeks to attain an equilibrium voltage. Equilibrium occurs when the sum of the average currents at the integrator summing node equals zero. At equilibrium, the current through A22R6 will be constant and equal to half the reference current. These two currents oppose each other at the integrator summing node for a net result of zero.

4-82. The equilibrium voltage is stored on capacitor A22C3. This voltage is the dc offset introduced by the analog section. During the following measure interval, the equilibrium voltage stored on A22C3 is applied to the integrator summing node where it nullifies the offset.

**4-83. Measure Interval.** Refer to Figure 4-12 and 4-14 for this discussion. Following the 2048 pulse auto-zero interval, the M/Z logic goes high to begin the measure interval. The M/Z logic switches the buffer amplifier input from ground to the analog voltage supplied to the panel meter. It also opens the closed-loop system of integrator and auto-zero amplifier. The voltage-to-current converter comprised of the buffer amplifier and A22R7 supplies a current to the integrator summing node generated by the analog input voltage. This additional current flowing into the integrator summing node disrupts the balance achieved during the preceding auto-zero interval. The result is the integrator output is driven away from the equilibrium voltage maintained as a reference on A22C3. The greater the analog input voltage, the greater the integrator output deviates from the equilibrium voltage. A22CR1 in parallel with the integrator capacitor A22C2 protects the integrator against large positive analog input voltages.

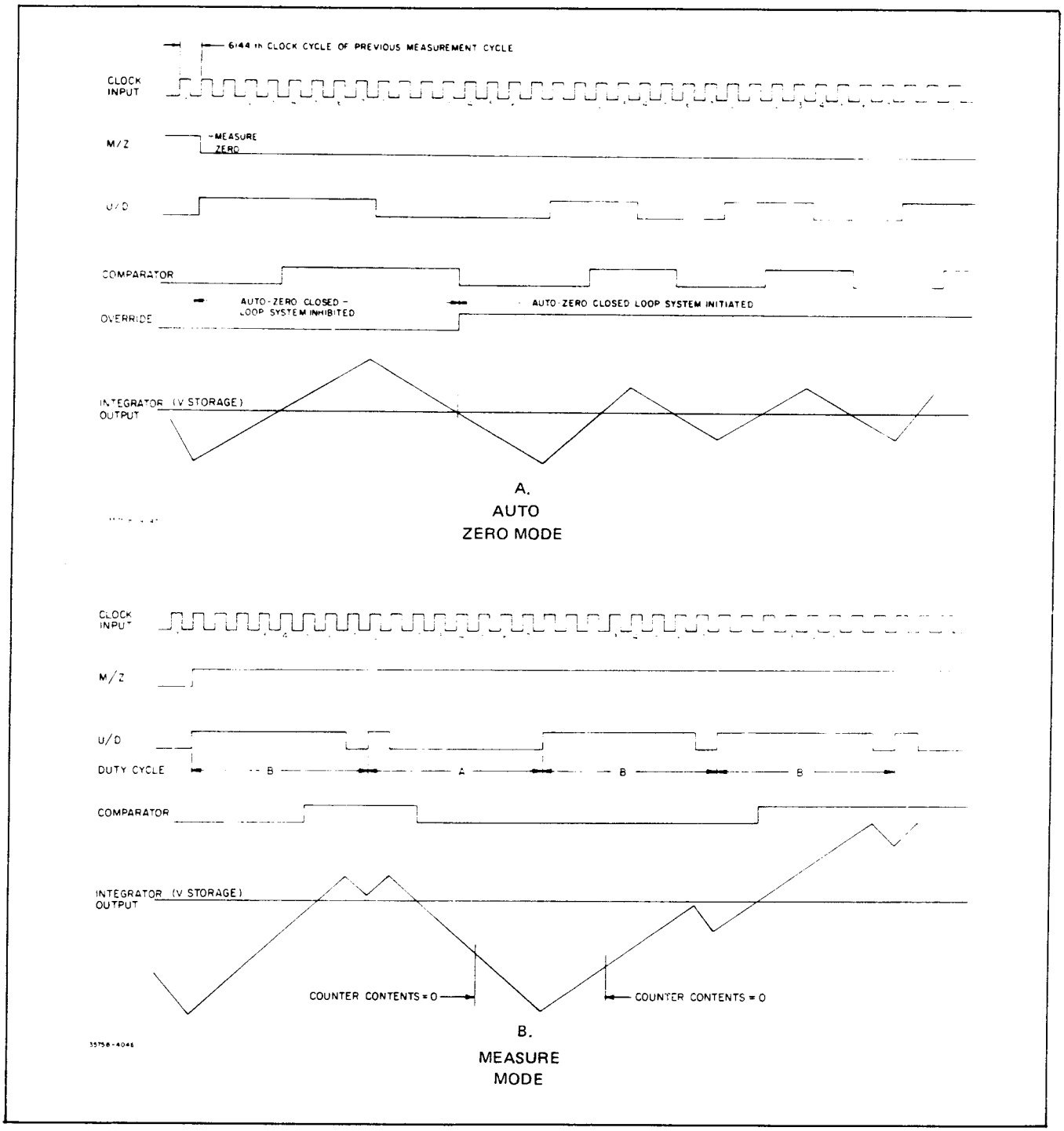



**Figure 4-13. Analog and Digital Timing.**

4-84. The comparator of A22U1 is a differential amplifier which compares the integrator output to the equilibrium voltage stored on A22C3. The comparator transmits by logic levels to the control logic of A22U2, the state of the integrator output with respect to the equilibrium voltage. A high logic level indicates an integrator output greater than equilibrium; a low logic level indicates an integrator output less than equilibrium. The control logic attempts to reestablish the system equilibrium by using one of two U/D logic duty cycles during the measure interval. The duty cycle used depends on the comparator output in the clock cycle preceding each duty cycle. Figure 4-13 shows the timing of these duty cycles and their effect on the integrator output.

4-85. Each duty cycle is comprised of eight clock cycles. Duty cycle A shown in Figure 4-13, consists of the U/D logic high one clock cycle and low seven clock cycles. As indicated in Figure 4-13, the U/D logic high drives the integrator output up and when low, it drives the integrator output down. Duty cycle A is used to drive the integrator output in a negative direction. Duty cycle B consists of seven clock cycles high and one clock cycle low. This duty cycle is used to drive the integrator output in a positive direction. The Control Logic of A22U2 samples the comparator output in the clock cycle preceding each duty cycle. A high comparator output indicates the integrator output is more positive than the equilibrium voltage. This indication dictates the use of duty cycle A which will drive the integrator output more negative in an attempt to reestablish the system equilibrium. A low comparator output dictates the use of duty cycle B to drive the integrator output more positive towards equilibrium.

4-86. Throughout the measure interval the Control logic utilizes U/D logic duty cycle A or B to reestablish the integrator output at equilibrium. The synchronous Up/Down 3½ Decade BCD Counter in A22U2 increments each clock cycle for a high state of the U/D logic or decrements each clock cycle when the U/D logic is low. The net result on the count stored in the BCD Counter is a decrease of six counts for a duty cycle A or an increase of six counts for a duty cycle B. Because of the number of clock cycles in the measure interval, the counter can accumulate a maximum of 3072 counts. A count of 2000 corresponds to a full scale analog input voltage. Therefore, the Digital Panel Meter can display accurately an analog input voltage 150% of full-scale. This full-scale is not to be confused with the instrument front panel full-scale. The number of counts accumulated by the counter is proportional to the input voltage. The larger the input voltage, the greater the count accumulated in the counter during the measure interval. For input voltages that are not overrange, the system equilibrium is reestablished before the end of the measure interval. The remainder of the measure interval is characterized by the counter increasing by six counts one duty cycle and decreasing by six counts the following duty cycle. This net count of zero occurs as the integrator output is maintained at equilibrium, that is, the average output equals the equilibrium voltage. At the end of the measure interval, the counter continues to count for a number of clock cycles in the auto-zero interval. This period is governed by the state of the M/Z, U/D and comparator output logic. When all three states are low, the counting stops. At this point the integrator output equals the equilibrium voltage. Therefore, this override period compensates for the voltage difference between the integrator output and the equilibrium voltage and its corresponding count at the end of the measure interval.

4-87. When the override is complete, the BCD counter of A22U2 is put on "hold." The contents of the counter are loaded into the static latches of A22U2 along with underrange information decoded from the counter contents. Underrange is 5% of full scale and corresponds to a count of 100 counts. Once the counter contents have been loaded into the static latches, the counter is cleared. The contents of the static latches are transmitted to the multiplexer where they are multiplexed to the push-pull Data Buffers in BCD format. This operation is synchronized by the 1 of 4 Decode with the Digit Buffers which provide a digit strobe. The Digit Buffers strobe the digits in a 1, 3, 2 and 4 sequence where digit 4 is the most significant digit. The digit strobe is performed by the Digit Buffers applying a high output to the terminal of A21U1 associated with the digit of interest. A21U1 provides inverters at each of the inputs and transmits a low through a base resistor, A21R8 thru R11. This low appears on the base of the transistor switch associated with the strobed digit. A low on the base of A21Q1 thru Q4 forward biases the transistor and applies the + 5 V on the emitter to the associated digit in the display. This application of + 5 V activates this digit of the display. Simultaneous with the activation of the digit, the BCD output from the Data Buffers is transmitted to the Decoder/Driver, A21U1, which converts the BCD information to a seven-segment code. This seven-segment code being synchronized with the strobed digit, is displayed.

4-88. The polarity of the analog input voltage is determined by the state of the U/D logic when the BCD Counter is reset to zero. This information is loaded into the static latch once each measurement cycle. The control logic strobes the polarity sign by applying a high to the sign strobe terminal on A21U6. The sign strobe is performed once each measure interval. The polarity information located in the static latches is transmitted to the sign display.

**4-89. Polarity Sign Blanking.** If an analog input voltage is greater than a full-scale input of 1.999 V, the 3½ digit display will blink during the zero cycle of the counter. This blinking rate is equal to the sample rate. Although the display blinks for an analog input greater than full-scale of 1.999 V, an analog input voltage that is 150% of full-scale, or 2.999 V, is accurately displayed in the overrange blinking mode. Transistors A21Q5 and Q6 in conjunction with A21R12 and R13 provide a polarity sign blanking capability. When the instrument is operated in the DCA or DCV mode, a ground is supplied to the base of A21Q5. This ground forward biases A21Q5 and Q6 which supplies + 5 V to the anodes of the polarity sign segments (A21U5 pin 1). If the instrument is in the OHMS or ACV mode, + 5 V is applied to A21Q5. A21Q5 turns off and in turn reverse biases A21Q6. When A21Q6 is not conducting, + 5 V is removed from the anodes of the polarity sign segments (A21U5 pin 1) blanking the polarity sign.

**4-90. Reference Supply.** The reference voltage is obtained by reducing the instrument's + 12 V supply to a reference voltage of +6.2 V. Dropping resistor A22R7 reduces the supply voltage which is filtered by A22C3. A zener diode, A22CR2, is in parallel with C3 and clamps the reference voltage to +6.2 V. The reference voltage is supplied to A22U1 and is the source of the reference current supplied to the integrator summing mode.

**4-91. Trigger and Hold (Options 002, 003).** When a ground is applied to the LOCAL/REMOTE control line (P1, pin 50) the internal sampling in the Panel Meter is disabled. In this disabled or Hold condition, U1 pin 1 is held low and the M/Z high to low transitions on U1 pin 2 have no effect.

4-92. External triggering must be used to obtain successive meter readings or BCD outputs in the Hold condition. An external trigger pulse of greater than 1 ms applied to U1 pin 12 causes U2 pins 7 and 10 to be high. With pins 7 and 10 both high, pin 8 will go low. The corresponding low on pin 2 (CLR) causes pin 13 to go high which places a high on U1 pin 1 and the next low to high transition of the M/Z line allows the Panel Meter to take a reading. The high to low transition of the M/Z line, forces U2 pin 6 (CLR) low which again creates the Hold condition.

## 4-93. Interface Assembly (A16B Schematic No. 9).

4-94. The Interface Assembly (A16B) is installed in place of the Interface Substitution Assembly (A16A) in instruments equipped with the remote programming and dual panel meter options (Options 002, 003). The purpose of the Interface Assembly is to provide the decoding, timing and switching logic required for the BCD outputs and remote controlled functions.

**4-95. BCD Output Circuits.** The BCD output circuitry shown on the left-hand side of Schematic No. 9 (IC1 through IC12) receives measurement data from the two panel meters and converts this data into parallel BCD outputs that are available at the rear panel Interface connector. The circuit in the upper portion of the schematic (IC2–IC4) converts the data from the right-hand (phase) panel meter, while the circuit in the lower portion of the schematic (IC5–IC7) converts the data from the left-hand (amplitude) panel meter. Since the two BCD output circuits are identical, the following description of the "phase" circuit applies to both circuits.

4-96. The BCD output circuit is comprised of three decade counters (IC2–IC4), an overrange flip-flop (IC1A) and associated logic circuitry. To begin a measurement, the Reset line (XA16 pin 2) from the panel meter goes low and remains low for 33 ms. This resets the decade counters to 000 and clears the overrange flip-flop. When the Reset line goes high, a series of pulses from the Gated Clock output of the panel meter are fed into the decade counters. Since the number of pulses is equal to the panel meter reading, the accumulated count at the end of the measurement cycle provides the required output data. If the count is greater than 999, counter IC2 passes a "carry" pulse to the overrange flip-flop which provides a single-line overrange indication. In 3575A Option 002, the high-true BCD outputs from the decade counters are applied to inverter gates (IC8, IC9) which provide low-true BCD outputs at the Interface connector. In Option 003 instruments, the inverter gates are replaced by non-inverting drivers which provide high-true BCD outputs at the Interface connector. Jumpers on the A16B board permit selection of high-true (P) or low-true (N) logic for the overrange and polarity output lines.

**4-97. Controller Section.** The controller section of the Interface Assembly is located in the upper right portion of Schematic No. 9. This section is comprised of two 4-bit multiplexers (IC13 and IC14) and a Local/Remote control circuit (IC17B, IC18B). Each multiplexer has eight inputs and four outputs. Four of the inputs to each multiplexer come from the front panel controls and four come from the rear panel Interface connector, J1. The output lines go to the Function Switching Assembly (A8), the Phase Control Filter (A7), the Log Converter (A3/A4) and the Input Attenuators (A1/A2) to control the instrument functions. The multiplexers operate like 4-pole, double-throw switches where the four output lines are connected to either the front panel controls (Local) or the remote control lines (Remote). Switching is accomplished by applying a logical "1" (+5 V) or "0" (0 V) to IC13, IC14 pin 9 which connects to the Local/Remote line through NAND gate IC17B. With no input to the Local/Remote line or when local control is programmed by an external controller, the line is held positive causing the output of IC17B to go low. This disables the remote inputs to IC13 and IC14 and enables the inputs from the front panel controls. When ground is applied to the Local/Remote line, the output of IC17B goes high and control is transferred to the remote control lines. The eight remote control lines use ground true logic and are normally held in a "0" (False) condition by the pull-up resistors within R5.

4-98. Note that the local/remote line from the output of IC17B is also connected to a buffer/inverter stage, IC18B. When ground is applied to the Local/Remote line (Remote Control), the output of IC18B goes low supplying a "hold" to the panel meters. In the panel meters, the "hold" command disables the internal sampling and thereby inhibits measurements. In order to obtain meter readings or BCD outputs, it is then necessary to use external triggering. External triggering is accomplished by grounding the Remote/Measure line (J1 pin 21) which controls the timing circuits discussed in the following paragraphs. In some cases, it is desirable to use external triggering and, at the same time, control the instrument from the front panel. To accomplish this, a jumper is provided at the output of IC17B. When the jumper is connected between terminals 1 and 3 (gnd), the front panel controls remain operative and the remote lines that control front panel functions are disabled.

**4-99. Timing Circuits.** In the Remote Control mode, it is necessary to trigger the panel meters by applying a momentary ground to the Remote Measure line each time a meter reading or BCD output is required. Grounding the Remote Measure line sets the data flag and initiates a variable time delay which, in turn, triggers the panel meters and initiates the measurement cycle.

4-100. The external trigger and flag timing circuit is shown in the lower right-hand portion of Schematic No. 9 and in the Timing Circuits Functional Block Diagram, Figure 4-14 Refer to Figure 4-14 for the following discussion.

4-101. The timing circuits are comprised of a Trigger Flip Flop, A Flag Flip Flop, a Variable Delay, a 40 ms Delay and associated logic circuitry. Before the timing circuits can operate, remote operation must be selected by grounding the Local/Remote line. This disables the internal sampling in the panel meters and enables the timing circuits. With the Local/Remote line grounded, it is further necessary to momentarily ground the Remote Measure line to initiate the timing sequence and trigger the panel meters. Grounding the Remote Measure line causes the output of IC16A to go high. This, in turn, initiates the Variable Time Delay and sets the Flag Flip Flop. Note that the two flip flops are set and reset by a low (0) rather than a high (1). This is the reason for the inverter between the output of IC16A and the "set" side of the Flag Flip Flop. When a "set" command is applied to the Flag Flip Flop, the + Data Flag line goes low and the - Data Flag line goes high. Since the + Flag line ($\overline{Q}$) is fed back to the input of IC16A, the output of IC16A remains high until the Flag Flip Flop is reset. The Variable Delay is initiated by a Logical 1 at the output of IC16A and controlled by the two frequency range lines, FR1 and FR2. Delay time is determined by the frequency range setting as indicated in Table 4-6. At the end of the delay period, the output of the Variable Delay circuit goes low applying a "set" command to the Trigger Flip-Flop. When "set", the $\overline{Q}$ side of the Trigger Flip-Flop goes low to trigger the panel meters. When the panel meters are triggered, the (L) Flag input from Panel Meter 1 goes high and remains high during the 100 ms measurement period. When the measurement is complete, the Flag line goes low, initiating the 40 ms time delay. When the 40 ms delay has elapsed, the output of the delay circuit goes low, applying a "reset" command to both flip-flops. This causes the panel meter Trigger line and the + Data Flag line to go high and the - Data Flag line to go low. Resetting the data flags indicates to an external controller that data is ready at the BCD outputs.

**Table 4-6. Variable Time Delays.**

| Frequency Range | Variable Delay |
|---|---|
| 1 Hz - 1 kHz | 33 sec. |
| 10 Hz - 100 kHz | 3.3 sec. |
| 100 Hz - 1 MHz | 0.42 sec. |
| 1 kHz - 13 MHz | 0.02 sec. |

4-102. The purpose of the Variable Delay in the timing circuit is to ensure that the instrument has been given sufficient settling time before the data flags are returned. Since the actual settling time of the instrument is often less than the time provided by the Variable Delay circuit, the user may find it convenient to bypass the Variable Delay. This can be accomplished by applying a continuous ground to the Trigger Mode line. Grounding the Trigger Mode line disables the Variable Delay circuit and enables IC17A. When a momentary ground is applied to the Remote Measure line, the output of IC16A goes high, the output of IC17A goes low and the two flip-flops are set simultaneously. At the end of the 140 ms measurement cycle, both flip-flops are reset, the Trigger line goes high and the data flags are returned to their original states.

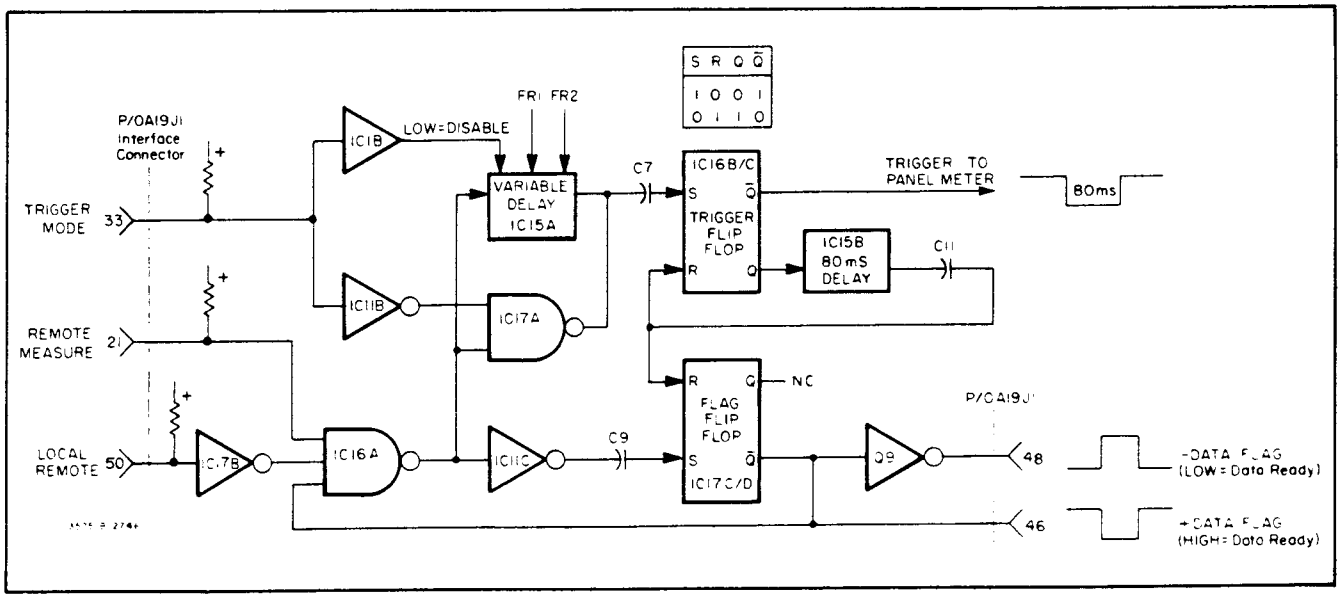



**Figure 4-14. Timing Circuits Functional Block Diagram.**

and four outputs. Four of the inputs to each multiplexer come from the front panel controls and four come from the rear panel Interface connector, J1. The output lines go to the Function Switching Assembly (A8), the Phase Control Filter (A7), the Log Converter (A3/A4) and the Input Attenuators (A1/A2) to control the instrument functions. The multiplexers operate like 4-pole, double-throw switches where the four output lines are connected to either the front panel controls (Local) or the remote control lines (Remote). Switching is accomplished by applying a logical "1" (+5 V) or "0" (0 V) to IC13, IC14 pin 9 which connects to the Local/Remote line through NAND gate IC17B. With no input to the Local/Remote line or when local control is programmed by an external controller, the line is held positive causing the output of IC17B to go low. This disables the remote inputs to IC13 and IC14 and enables the inputs from the front panel controls. When ground is applied to the Local/Remote line, the output of IC17B goes high and control is transferred to the remote control lines. The eight remote control lines use ground true logic and are normally held in a "0" (False) condition by the pull-up resistors within R5.

4-101. Note that the local/remote line from the output of IC17B is also connected to a buffer/inverter stage, IC18B. When ground is applied to the Local/Remote line (Remote Control), the output of IC18B goes low supplying a "hold" to the panel meters. In the panel meters, the "hold" command disables the internal sampling and thereby inhibits measurements. In order to obtain meter readings or BCD outputs, it is then necessary to use external triggering. External triggering is accomplished by grounding the Remote/Measure line (J1 pin 21) which controls the timing circuits discussed in the following paragraphs. In some cases, it is desirable to use external triggering and, at the same time, control the instrument from the front panel. To accomplish this, a jumper is provided at the output of IC17B. When the jumper is connected between terminals 1 and 3 (gnd), the front panel controls remain operative and the remote lines that control front panel functions are disabled.

**4-102. Timing Circuits.** In the Remote Control mode, it is necessary to trigger the panel meters by applying a momentary ground to the Remote Measure line each time a meter reading or BCD output is required. Grounding the Remote Measure line sets the data flag and initiates a variable time delay which, in turn, triggers the panel meters and initiates the measurement cycle.

4-103. The external trigger and flag timing circuit is shown in the lower right-hand portion of Schematic No. 9 and in the Timing Circuits Functional Block Diagram, Figure 4-15. Refer to Figure 4-15 for the following discussion.

4-104. The timing circuits are comprised of a Trigger Flip Flop, A Flag Flip Flop, a Variable Delay, a 40 ms Delay and associated logic circuitry. Before the timing circuits can operate, remote operation must be selected by grounding the Local/Remote line. This disables the internal sampling in the panel meters and enables the timing circuits. With the Local/Remote line grounded, it is further necessary to momentarily ground the Remote Measure line to initiate the timing sequence and trigger the panel meters. Grounding the Remote Measure line causes the output of IC16A to go high. This, in turn, initiates the Variable Time Delay and sets the Flag Flip Flop. Note that the two flip flops are set and reset by a low (0) rather than a high (1). This is the reason for the inverter between the output of IC16A and the "set" side of the Flag Flip Flop. When a "set" command is applied to the Flag Flip Flop, the + Data Flag line goes low and the - Data Flag line goes high. Since the + Flag line ($\overline{Q}$) is fed back to the input of IC16A, the output of IC16A remains high until the Flag Flip Flop is reset. The Variable Delay is initiated by a Logical 1 at the output of IC16A and controlled by the two frequency

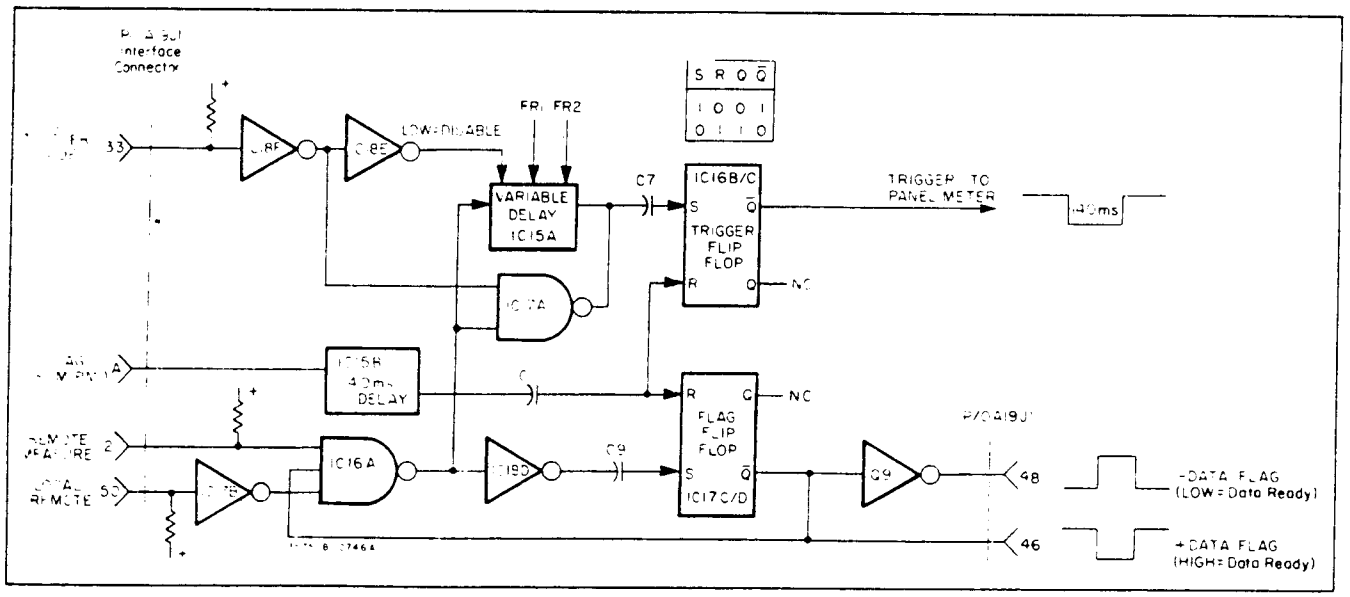



Figure 4-15. Timing Circuits Functional Block Diagram.

range lines, FR1 and FR2. Delay time is determined by the frequency range setting as indicated in Table 4-6. At the end of the delay period, the output of the Variable Delay circuit goes low applying a "set" command to the Trigger Flip-Flop. When "set", the $\overline{Q}$ side of the Trigger Flip-Flop goes low to trigger the panel meters. When the panel meters are triggered, the (L) Flag input from Panel Meter 1 goes high and remains high during the 100 ms measurement period. When the measurement is complete, the Flag line goes low, initiating the 40 ms time delay. When the 40 ms delay has elapsed, the output of the delay circuit goes low, applying a "reset" command to both flip-flops. This causes the panel meter Trigger line and the + Data Flag line to go high and the - Data Flag line to go low. Resetting the data flags indicates to an external controller that data is ready at the BCD outputs.

4-105. The purpose of the Variable Delay in the timing circuit is to ensure that the instrument has been given sufficient settling time before the data flags are returned. Since the actual settling time of the instrument is often less than the time provided by the Variable Delay circuit, the user may find it convenient to bypass the Variable Delay. This can be accomplished by applying a continuous ground to the Trigger Mode line. Grounding the Trigger Mode line disables the Variable Delay circuit and enables IC17A. When a momentary ground is applied to the Remote Measure line, the output of IC16A goes high, the output of IC17A goes low and the two flip-flops are set simultaneously. At the end of the 140 ms measurement cycle, both flip-flops are reset, the Trigger line goes high and the data flags are returned to their original states.

**Table 4-6. Variable Time Delays.**

| Frequency Range | Variable Delay |
|---|---|
| 1 Hz - 1 kHz | 33 sec |
| 10 Hz - 100 kHz | 3.3 sec |
| 100 Hz - 1 MHz | 0.42 sec. |
| 1 kHz - 13 MHz | 0.02 sec. |

**WARNING**

*Maintenance described herein is performed with power supplied to the instrument, and protective covers removed. Such maintenance should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.*

G.R.B. LAB.

# SECTION V
# MAINTENANCE

## 5-1. INTRODUCTION.

5-2. This section contains complete maintenance information for the Model 3575A Gain-Phase Meter. Included are performance checks, adjustment procedures, troubleshooting techniques and instructions for the removal and replacement of various assemblies and components.

## 5-3. RECOMMENDED TEST EQUIPMENT.

5-4. The test equipment that is recommended for maintaining the Model 3575A is listed in Table 5-1. If the recommended model is not available, any instrument that has specifications equal to or better than the required specifications can be used.

**Table 5-1. Recommended Test Equipment.**

| Instrument Type | Required Characteristics | Usage | | | Recommended Model |
|---|---|---|---|---|---|
| | | Performance Checks | Adjustments | Trouble-Shooting | |
| DC Digital Voltmeter | Full Scale Ranges: 100 mV through 100 V<br>Input Resistance: 10 Megohms<br>Accuracy: 0.1% of reading | X | X | X | -hp- 3450B |
| Frequency Synthesizer (See Note 1) | Frequency Range: 1 Hz to 13 MHz<br>Output Levels: + 19 dBm to + 26 dBm (50 ohms)<br>Amplitude Accuracy: 1 Hz to 10 Hz: ± 0.6 dB<br>10 Hz to 13 MHz: ± 0.1 dB | X | X | X | -hp- 3320B |
| Variable Attenuator | Attenuation: 80 dB in 10 dB steps<br>Frequency Range: 1 Hz to 13 MHz<br>Accuracy: ± 0.3 dB (or of known accuracy)<br>Impedance: 50 ohms | X | X | | -hp- 355D |
| Power Amplifier | Voltage Gain: X10 (20 dB)<br>Maximum Output: 20 V p-p<br>Frequency Range: 1 Hz to 1 MHz<br>Accuracy: 1 Hz to 100 kHz: ± 1%<br>100 kHz to 1 MHz: ± 5%<br>(or of known accuracy) | X | | | -hp- 467A |
| Oscilloscope | Sensitivity: 0.005 V/cm to 10 V/cm<br>Sweep: 0.05 μsec/cm to 0.1 sec/cm | | | X | -hp- 180C |
| Voltage Divider Probe (for oscilloscope) | Division: 10:1<br>Impedance: 10 Megohms, 10 pF | | | X | -hp- 10004A |
| DC Power Supply | Variable Range: -12 V dc to + 12 V dc | | | X | -hp- 467A |
| Variable Phase Generator (See Note 2) | Output Frequency: 1 kHz<br>Output Level: 2 V rms<br>Variable Phase Range: 0° to 360° | | | X | -hp- 203A |
| Power Splitter (See Figure 5-1) | Impedance: 50 ohms | X | X | | See Figure 5-1 |
| R/C Phase Shift Network (See Figure 5-4) | Phase Shift: 90 degrees<br>Frequency Range: 100 Hz to 13 MHz | X | | | See Figure 5-4 |
| Terminations | 50-Ohm Feed-Thru (2 required) | X | X | X | -hp- 11048C |
| Cables | (1) 48" 50-Ohm Cable (BNC connectors)<br>(2) 24" 50-Ohm Cables (BNC connectors)<br>(1) 9" 50-Ohm Cable (BNC connectors) | X<br>X<br>X | | | -hp- 11170C<br>-hp- 11170B<br>-hp- 10502A |
| Connector | Male-to-Male | X | | | -hp-1250-0216 |
| Adapters | (2) BNC to Binding Post Adapters<br>(1) BNC "T" Connector | X<br>X | | | -hp- 10110A |
| Resistor | R: fxd flm 1 Megohm ± 1% 1/2 W | X | | | -hp- Part No. 0757-0059 |

NOTES:
1. If a Frequency Synthesizer is not available, a Test Oscillator such as the -hp- Model 651B can be used on a limited basis.
2. A dc power supply with a variable range of -2 V dc to + 2 V dc (-hp- Model 467A) can be used in place of the Variable Phase Generator for troubleshooting.

## 5-5. PERFORMANCE CHECKS.

5-6. The following performance checks are in-cabinet procedures that can be used to verify that the Model 3575A meets the specifications listed in Table 1-1. These procedures can be used for incoming quality control inspection, to check specifications after a repair or for routine maintenance.

### 5-7. Test Card.

5-8. A Performance Check Test Card is provided at the end of this section for your convenience in recording the performance of the Model 3575A during performance checks. This card can be removed from the manual and used as a permanent record of the incoming inspection or of a routine performance check. The test card may be reproduced without written permission from Hewlett-Packard.

### 5-9. Panel Meter Accuracy Check.

5-10. The purpose of this check is to verify that the panel meter accuracy is within the ± 3 count (± 0.3 dB, ± 0.3 deg.) tolerance listed in Table 1-1. If the panel meter fails to meet the required specifications, perform the Panel Meter Accuracy Adjustments (Paragraph 5-29) before proceeding with the other performance checks in this section.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)
Frequency Synthesizer (-hp- Model 3320B)
Variable Attenuator (-hp- Model 355D)
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
50-Ohm Power Splitter (See Figure 5-1)

a. Connect test equipment as shown in Figure 5-2. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.

b. Set the 3575A controls as follows:

DISPLAY* ..... AMPLITUDE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE ....1 Hz - 1 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set AMPLITUDE B/PHASE switch to PHASE.

c. Set the Frequency Synthesizer amplitude to + 25.05 dBm (2 V rms at outputs of Power Splitter) and frequency to 1 kHz.

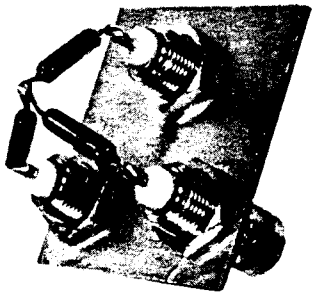
d. Set the Variable Attenuator to 0 dB.

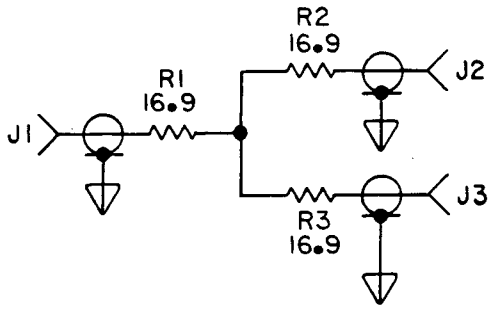
e. Allow 30 seconds for the readings to stabilize.

f. Observe the DC Digital Voltmeter reading and the B/A panel meter reading. The panel meter reading should be within ± 3 counts of the DVM reading e.g., the analog output voltage is 10 mV per dB. An output of + 1 mV dc should, therefore, produce a panel meter reading of + 00.1 dB ± 0.3 dB (3 counts).

g., Set the Variable Attenuator to 80 dB and allow 30 seconds for the readings to stabilize.

h. Observe the DVM reading and the B/A panel meter reading. The panel meter reading should be within ± 3 counts of the DVM reading e.g., if the DVM reading is - 0.797 Vdc, the panel meter reading should be - 79.7 dB ± 0.3 dB.






Parts List.

| Designator | Description | -hp- Part No. |
|---|---|---|
| J1 - J3 | Connector: BNC female | 1250-0083 |
| R1 - R3 | R: fxd film 16.9 ohms 1 % 1/2 W | 0698-5005 |
| Board | 1.5" X 1.5" Copper-Clad (double-sided) | |

Figure 5-1. Power Splitter.

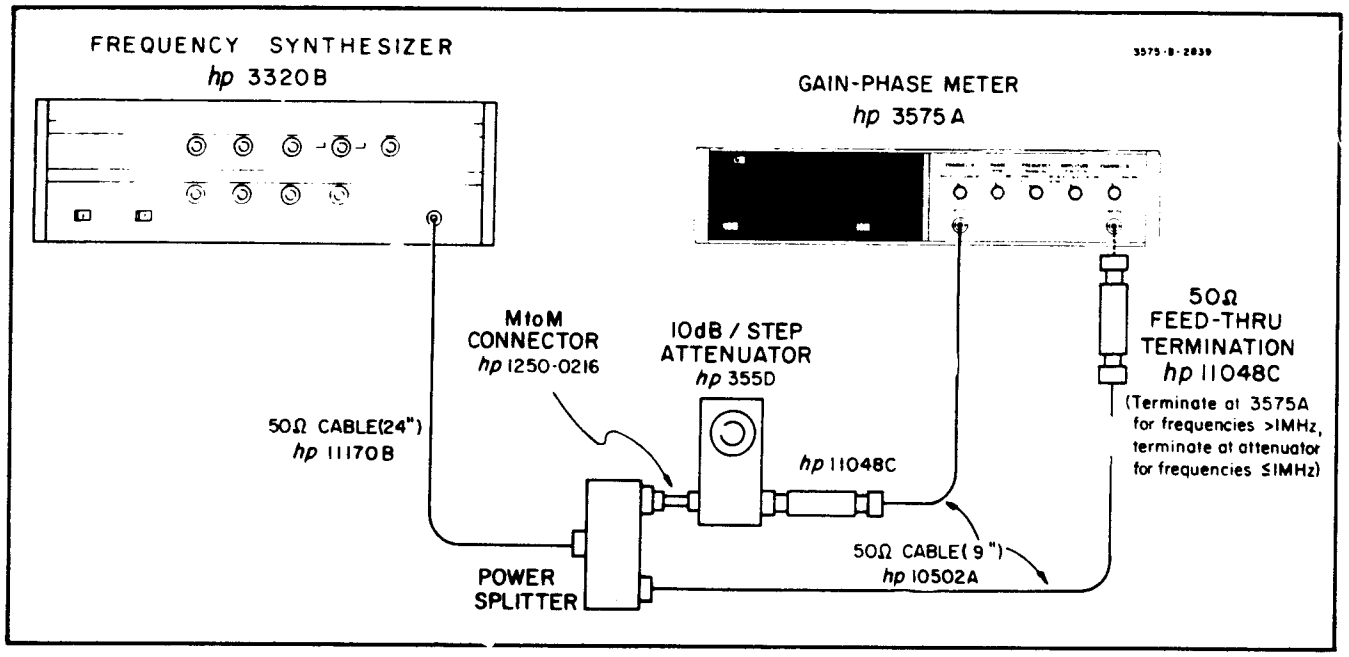



**Figure 5-2. Amplitude and Phase Accuracy Checks.**

i. Without disturbing the 3575A or test equipment control settings, reverse the input connections to the 3575A so the Variable Attenuator is connected to Channel A and the Power Splitter is connected to Channel B. Allow 30 seconds for the readings to stabilize.

j. Observe the DVM reading and the B/A panel meter reading. The panel meter reading should be within ± 3 counts of the DVM reading e.g., if the DVM reading is + 0.802 Vdc, the panel meter reading should be + 80.2 dB ± 0.3 dB.

k. Options 001–003: Perform the following additional steps to verify the accuracy of the right-hand (phase) panel meter.

l. Connect the DC Digital Voltmeter to ANALOG OUTPUT 2.

m. Set the Variable Attenuator to 0 dB and allow 30 seconds for the readings to stabilize.

n. Observe the DVM reading and the right-hand panel meter reading. The panel meter reading should be within ± 3 counts of the DVM reading.

o. Set the PHASE REFERENCE switch to the - A position and allow 30 seconds for the readings to stabilize.

p. Observe the DVM reading and the right-hand panel meter reading. The panel meter reading should be within ± 3 counts of the DVM reading.

## 5-11. Amplitude and Phase Accuracy Checks.

5-12. The purpose of these checks is to verify that the 3575A meets the amplitude and phase accuracy specifications listed in Table 1-1. Read Section III, Paragraphs 3-13 to 3-16 before performing the following tests. If the 3575A fails to meet any of the required specifications, perform the adjustments outlined in Paragraphs 5-25 through 5-46.

*NOTE*

*The checks outlined in the following procedure will verify the 3575A phase accuracy at 0 degrees and 180 degrees at critical levels and frequencies throughout the operating range of the instrument. Satisfactory performance during these checks is reasonable verification that the phase detector circuits are operating properly. Marginal performance, however, may reflect a misadjustment or malfunction that could degrade the overall performance and produce readings that are out of tolerance at points other than 0 degrees and 180 degrees. If performance appears marginal or if further verification of phase accuracy is desired, "spot check" the 45 degree points and/or the 90 degree points using a precision phase generator or refer to the Supplemental Phase Accuracy Check outlined in Paragraph 5-17.*

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)
Variable Attenuator (-hp- Model 355D)
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
50-Ohm Power Splitter (See Figure 5-1)
(1) 48" 50-Ohm Cable with BNC connectors (-hp- 11170C)
(2) 24" 50-Ohm Cables with BNC connectors (-hp- 11170B)
(1) 9" 50-Ohm Cable with BNC connectors (-hp- 10502A)

a. Connect test equipment as shown in Figure 5-2. Note that the cable lengths are critical and must be as specified in Figure 5-2.

b. Turn on all equipment and allow a warmup period of at least 1 hour before proceeding.

c. Set the 3575A controls as follows:

DISPLAY* ..... AMPLITUDE
AMPLITUDE FUNCTION ..... B
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE ....1 Hz - 1 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE so that amplitude and phase can be observed simultaneously. Disregard any further references to the DISPLAY switch in the following steps.

d. Set the Frequency Synthesizer amplitude to + 25.05 dBm (2 V rms at outputs of Power Splitter) and frequency to 1 Hz with Leveling switch to OFF.

e. Set the Variable Attenuator to 0 dB.

f. Allow time for the 3575A reading to stabilize.

g. The channel B amplitude reading (B dBV) should be within the tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

h. Set the AMPLITUDE FUNCTION switch to B/A and allow time for the reading to stabilize.

i. The B/A reading should be within the tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

j. Reset the AMPLITUDE FUNCTION switch to B. Set the DISPLAY switch to PHASE and allow time for the phase reading to stabilize.

k. The 3575A phase reading should be 0 degrees ± tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

l. Reset the DISPLAY switch to AMPLITUDE.

m. Repeat Steps f through l for each input frequency and attenuator setting listed in Table 5-2. For frequencies greater than 10 Hz, the 3320B Leveling switch must be set to ON. Note that the 3575A Voltage Range and Frequency Range switches must be set as indicated in the table. For most of the checks listed in Table 5-2, the Voltage Range switches should be set to the 0.2 mV - 2 V position. At various points in the table, however, the 2 mV to 20 V range is specified. The reason for this is to spot check the amplitude readings on the high range. These particular checks do not apply to phase since phase must be measured on the lowest applicable range.

*NOTE*

*When the point is reached where the input frequency is 1 MHz and above, reverse the Channel A input connection so that both signals are terminated at the 3575A input connectors.*

n. Again reverse the Channel A input connection so the termination is at the output of the Power Splitter as shown in Figure 5-2. Connect the terminated output from the Power Splitter to Channel B and the terminated output from the Variable Attenuator to Channel A.

o. Set the 3575A controls as follows:

DISPLAY ..... AMPLITUDE
AMPLITUDE FUNCTION ..... A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE ....1 Hz - 1 kHz
PHASE REFERENCE ..... - A

p. Set the Frequency Synthesizer amplitude to + 25.05 dBm, frequency to 1 Hz and Leveling to OFF.

q. Set the Variable Attenuator to 0 dB.

r. Allow time for the 3575A reading to stabilize.

s. The channel A amplitude reading (A dBV) should be within the tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

t. Set the AMPLITUDE FUNCTION switch to B/A and allow time for the reading to stabilize.

u. The B/A reading should be within the tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

v. Reset the AMPLITUDE FUNCTION switch to A and PHASE REFERENCE to - A. Set the DISPLAY switch to PHASE and allow time for the phase reading to stabilize.

w. The 3575A phase reading should be - 180 degrees or + 180 degrees ± tolerances listed in Table 5-2 for the corresponding input frequency and attenuator setting.

x. Reset the DISPLAY switch to AMPLITUDE.

y. Repeat Steps r through x for each input frequency and attenuator setting listed in Table 5-2. For frequencies greater than 10 Hz, the 3320B Leveling switch must be set to ON. Use the Voltage Range and Frequency Range settings indicated in the table.

*NOTE*

*When the point is reached where the input frequency is 1 MHz and above, reverse the Channel B input connection so that both signals are terminated at the 3575A input connectors.*

Table 5-2. Amplitude and Phase Accuracy Checks.

| Input Frequency | Variable Attenuator | Voltage Range | Frequency Range | A OR B (dBV) | B/A (+ or - dB) | Phase ($0^{o}$ or $180^{o}$) |
|---|---|---|---|---|---|---|
| 1 Hz | 0 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 0.8 |
| 1 Hz | 30 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 24.0 ± 1.3 | 30.0 ± 1.3 | ± 0.8 |
| 1 Hz | 40 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 34.0 ± 1.3 | 40.0 ± 1.3 | ± 1.3 |
| 1 Hz | 50 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ± 2.3 |
| 1 Hz | 50 dB | 2 mV - 20 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ------ |
| 1 Hz | 60 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 54.0 ± 1.3 | 60.0 ± 1.8 | ± 5.3 |
| 1 Hz | 70 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 64.0 ± 1.3 | 70.0 ± 1.8 | ------ |
| 1 Hz | 80 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ------ |
| 10 Hz | 0 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 0.8 |
| 10 Hz | 40 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 34.0 ± 1.3 | 40.0 ± 1.3 | ± 0.8 |
| 10 Hz | 50 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ± 1.3 |
| 10 Hz | 50 dB | 2 mV - 20 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ------ |
| 10 Hz | 60 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 54.0 ± 1.3 | 60.0 ± 1.8 | ± 2.3 |
| 10 Hz | 70 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 64.0 ± 1.3 | 70.0 ± 1.8 | ± 5.3 |
| 10 Hz | 80 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ± 10.3 |
| 200 Hz | 0 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 0.8 |
| 200 Hz | 40 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 34.0 ± 1.3 | 40.0 ± 1.3 | ± 0.8 |
| 200 Hz | 50 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ± 1.3 |
| 200 Hz | 50 dB | 2 mV - 20 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ------ |
| 200 Hz | 60 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 54.0 ± 1.3 | 60.0 ± 1.8 | ± 2.3 |
| 200 Hz | 70 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 64.0 ± 1.3 | 70.0 ± 1.8 | ± 5.3 |
| 200 Hz | 80 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ± 10.3 |
| 500 Hz | 0 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 0.8 |
| 500 Hz | 30 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 24.0 ± 1.3 | 30.0 ± 1.3 | ± 0.8 |
| 500 Hz | 40 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 34.0 ± 1.3 | 40.0 ± 1.3 | ± 1.3 |
| 500 Hz | 50 dB | 0.2 mV - 2 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ± 1.3 |
| 500 Hz | 50 dB | 2 mV - 20 V | 1 Hz - 1 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ------ |
| 2 kHz | 60 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 54.0 ± 1.3 | 60.0 ± 1.8 | ± 2.3 |
| 5 kHz | 70 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 64.0 ± 1.3 | 70.0 ± 1.8 | ± 5.3 |
| 20 kHz | 0 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 0.8 |
| 50 kHz | 0 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 1.3 |
| 50 kHz | 30 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 24.0 ± 1.3 | 30.0 ± 1.3 | ± 5.3 |
| 50 kHz | 40 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 34.0 ± 1.3 | 40.0 ± 1.3 | ± 5.3 |
| 50 kHz | 60 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 54.0 ± 1.3 | 60.0 ± 1.8 | ± 10.3 |
| 50 kHz | 60 dB | 2 mV - 20 V | 10 Hz - 100 kHz | - 54.0 ± 2.3 | 60.0 ± 2.8 | ------ |
| 50 kHz | 80 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ± 10.3 |
| 100 kHz | 0 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 1.3 |
| 100 kHz | 50 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 44.0 ± 1.3 | 50.0 ± 1.8 | ± 5.3 |
| 100 kHz | 70 dB | 0.2 mV - 2 V | 10 Hz - 100 kHz | - 64.0 ± 1.3 | 70.0 ± 1.8 | ± 10.3 |
| 200 kHz | 0 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 2.3 |
| 200 kHz | 80 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ± 10.3 |
| 1 MHz | 0 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | + 6.0 ± 1.3 | 00.0 ± 1.3 | ± 5.3 |
| 1 MHz | 30 dB | 2 mV - 20 V | 100 Hz - 1 MHz | - 24.0 ± 2.3 | 30.0 ± 2.8 | ------ |
| 1 MHz | 40 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | - 34.0 ± 1.3 | 40.0 ± 1.8 | ± 10.3 |
| 1 MHz | 50 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | - 44.0 ± 2.3 | 50.0 ± 2.8 | ± 10.3 |
| 1 MHz | 60 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | - 54.0 ± 2.3 | 60.0 ± 2.8 | ± 10.3 |
| 1 MHz | 80 dB | 0.2 mV - 2 V | 100 Hz - 1 MHz | - 74.0 ± 2.3 | 80.0 ± 2.8 | ± 20.3 |
| 2 MHz | 0 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | + 6.0 ± 2.3 | 00.0 ± 2.3 | ± 5.3 |
| 2 MHz | 50 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 44.0 ± 2.3 | 50.0 ± 3.3 | ± 10.3 |
| 2 MHz | 80 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 74.0 ± 3.3 | 80.0 ± 4.3 | ± 20.3 |
| 5 MHz | 0 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | + 6.0 ± 2.3 | 00.0 ± 2.3 | ± 10.3 |
| 5 MHz | 40 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 34.0 ± 2.3 | 40.0 ± 3.3 | ± 20.3 |
| 5 MHz | 60 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 54.0 ± 2.3 | 60.0 ± 3.3 | ------ |
| 13 MHz | 0 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | + 6.0 ± 2.3 | 00.0 ± 2.3 | ± 20.3 |
| 13 MHz | 20 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 14.0 ± 2.3 | 20.0 ± 3.3 | ± 20.3 |
| 13 MHz | 40 dB | 2 mV - 20 V | 1 kHz - 13 MHz | - 34.0 ± 2.3 | 40.0 ± 3.3 | ------ |
| 13 MHz | 60 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 54.0 ± 2.3 | 60.0 ± 3.3 | ------ |
| 13 MHz | 80 dB | 0.2 mV - 2 V | 1 kHz - 13 MHz | - 74.0 ± 3.3 | 80.0 ± 4.3 | ------ |

## 5-13. High Level Accuracy Checks.

5-14. The purpose of these checks is to verify that the 3575A meets the amplitude and phase accuracy specifications with the Voltage Range switches set to the 2 mV - 20 V position. These checks are performed with 20 V rms applied to both inputs.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)*
Power Amplifier (-hp- Model 467A)
50-Ohm Feed-Thru Termination (-hp- Model 11048C)

* A Test Oscillator such as the -hp- Model 651B can be used in place of the Frequency Synthesizer.

a. Connect the 50-Ohm output of the Frequency Synthesizer, terminated in 50-ohm load, to the input of the Power Amplifier. Using a BNC Tee connector and two equal length cables with BNC connectors, connect the Power Amplifier output to the 3575A inputs.

b. Set the 3575A controls as follows:

DISPLAY* ..... AMPLITUDE
AMPLITUDE FUNCTION ..... A
Voltage Range ..... 2 mV - 20 V (both channels)
FREQUENCY RANGE .... 1 Hz - 1 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE so that amplitude and phase can be observed simultaneously. Disregard any further references to the DISPLAY switch in the following steps.

c. Set the Power Amplifier gain to X10.

d. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms) and frequency to 1 Hz.

e. Allow time for the reading to stabilize.

f. The channel A amplitude reading (A dBV) should be + 26.0 dBV ± 1.3 dBV.

g. Set the DISPLAY switch to PHASE and allow time for the phase reading to stabilize.

h. The 3575A phase reading should be 0 degrees ± tolerances listed in Table 5-3 for the corresponding input frequency.

i. Reset the DISPLAY switch to AMPLITUDE.

j. Repeat Steps e through i with the Frequency Synthesizer set to each frequency listed in Table 5-3. Note that the 3575A Frequency Range switch must be set as indicated in the table.

Table 5-3. High Level Accuracy Checks.

| Input Frequency | Frequency Range | Phase ($0^o$ or $180^o$) |
|---|---|---|
| 1 Hz | 1 - 1 K | ± 0.8 deg. |
| 10 Hz | 1 - 1 K | ± 0.8 deg. |
| 100 Hz | 1 - 1 K | ± 0.8 deg. |
| 1 kHz | 1 - 1 K | ± 0.8 deg. |
| 10 kHz | 10 - 100 K | ± 0.8 deg. |
| 20 kHz | 10 - 100 K | ± 0.8 deg. |
| 50 kHz | 10 - 100 K | ± 1.3 deg. |
| 200 kHz | 100 - 1 M | ± 2.3 deg. |
| 1 MHz | 100 - 1 M | ± 5.3 deg. |

k. Set the Frequency Synthesizer frequency to 1 Hz.

l. Set the 3575A controls as follows:

DISPLAY ..... AMPLITUDE
AMPLITUDE FUNCTION ..... B
Voltage Range ..... 2 mV - 20 V (both channels)
FREQUENCY RANGE ..... 1 Hz - 1 kHz
PHASE REFERENCE ..... - A

m. Allow time for the reading to stabilize.

n. The channel B amplitude reading (B dBV) should be + 26.0 dBV ± 1.3 dBV.

o. Set the PHASE REFERENCE to - A and the DISPLAY switch to PHASE and allow time for the phase reading to stabilize.

p. The 3575A phase reading should be - 180 degrees or + 180 degrees ± tolerances listed in Table 5-3 for the corresponding input frequency.

q. Reset the DISPLAY switch to AMPLITUDE.

r. Repeat Steps m through q with the Frequency Synthesizer set to each frequency listed in Table 5-3.

## 5-15. Shunt Capacitance Check.

5-16. The purpose of this check is to verify that both channels meet the < 30 pF shunt capacitance specification listed in Table 1-1.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)*
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
50-Ohm Power Splitter (See Figure 5-1)
Resistor: 1 Megohm, ± 1 % 1/2 W (-hp- Part No. 0757-0059)

* A Test Oscillator such as the -hp- Model 651B can be used in place of the Frequency Synthesizer.

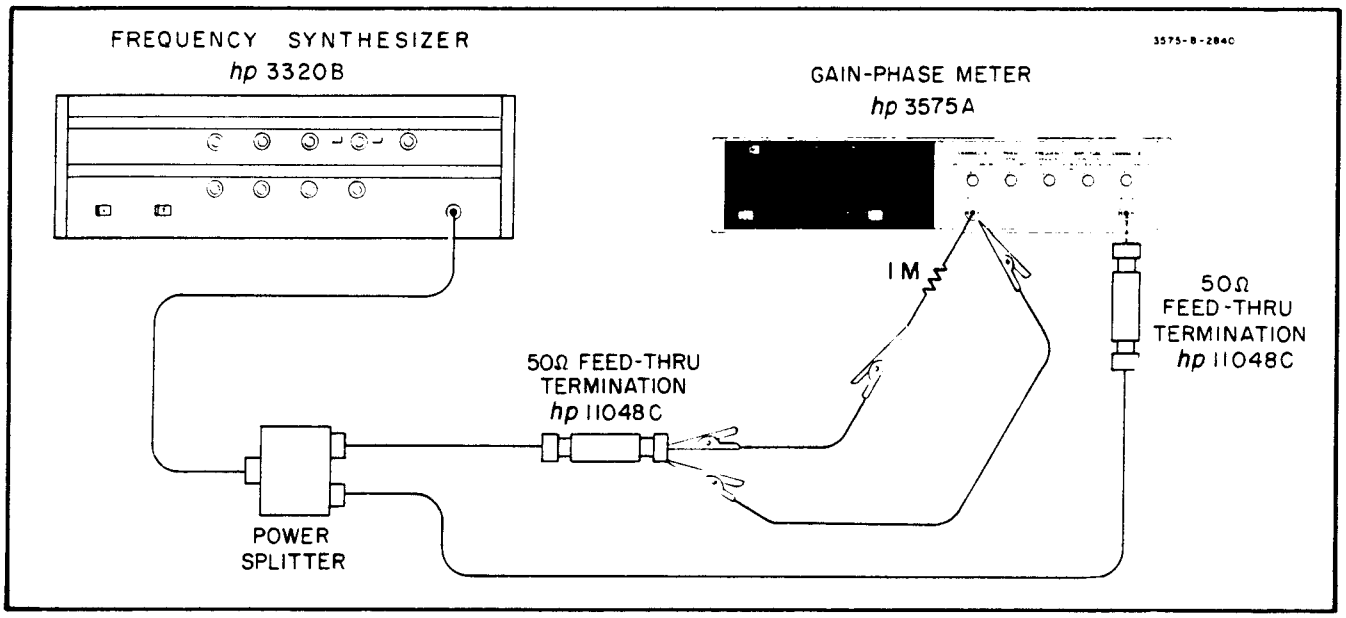



**Figure 5-3. Shunt Capacitance Check.**

a. Connect test equipment as shown in Figure 5-3. Insert one end of the 1 Megohm resistor into the Channel A input connector and connect the other end directly to the Feed-Thru Termination using a short clip lead. Use another short clip lead to connect the outer shield of the Feed-Thru Termination to the outer shield of the Channel A input connector.

b. Set the 3575A controls as follows:

DISPLAY* .....PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE . 100 Hz - 1 MHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE.

c. Set the frequency Synthesizer amplitude to +19.03 dBm (1 V rms at outputs of Power Splitter) and frequency to 10.6 kHz.

d. Allow time for the phase reading to stabilize.

e. The absolute value of the phase reading should be 45 degrees or less, verifying the < 30 pF shunt capacitance specification for the low range on channel A.

f. Set the Channel A Voltage Range switch to the 2 mV - 20 V position and allow time for the phase reading to stabilize.

g. The absolute value of the phase reading should be 45 degrees or less, verifying the < 30 pF shunt capacitance specification for the high range on channel A. Reset the Channel A range switch to the 0.2 mV - 2 V position.

h. Reverse the Channel A and Channel B input connections so the 1 Megohm resistor is in series with the Channel B input.

i. Allow time for the phase reading to stabilize.

j. The absolute value of the phase reading should be 45 degrees or less, verifying the < 30 pF shunt capacitance specification for the low range on channel B.

k. Set the Channel B Voltage Range switch to the 2 mV - 20 V position and allow time for the phase reading to stabilize.

l. The absolute value of the phase reading should be 45 degrees or less, verifying the < 30 pF shunt capacitance specification for the high range on channel B.

### 5-17. Supplemental Phase Accuracy Check.

5-18. The purpose of this check is to supplement the phase accuracy checks outlined in Paragraph 5-12. This check is included for the benefit of those who do not have a precision phase generator and desire to further verify the 3575A phase accuracy at 90 degrees. The test equipment required for this procedure includes a simple R/C phase shift network such as the one shown in Figure 5-4. The circuit shown in Figure 5-4 will produce an accurate 90 degree phase shift over the frequency range of 100 Hz to 13 MHz.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)*
50-Ohm Feed-Thru Termination (-hp- Model 11048C)
(2) BNC to Binding Post Adapters (-hp- 10110A)
R/C Phase Shift Network (See Figure 5-4)

* A Test Oscillator such as the -hp- Model 651B can be used in place of the Frequency Synthesizer.

a. Consruct an R/C network as shown in Figure 5-4.

b. Connect the two BNC to Binding Post Adaptors to the 3575A input connectors.

c. Connect the output leads of the R/C network to the 3575A inputs as shown in Figure 5-4. The leads from the R/C network to the 3575A should be of equal length and as short as possible.

d. Connect the 50-ohm output of the Frequency Synthesizer, terminated in 50-ohm load, to the input (J1) of the R/C network. Use a 50-ohm shielded cable to connect the Frequency Synthesizer output to the Feed-Thru Termination.

e. Set the 3575A controls as follows:

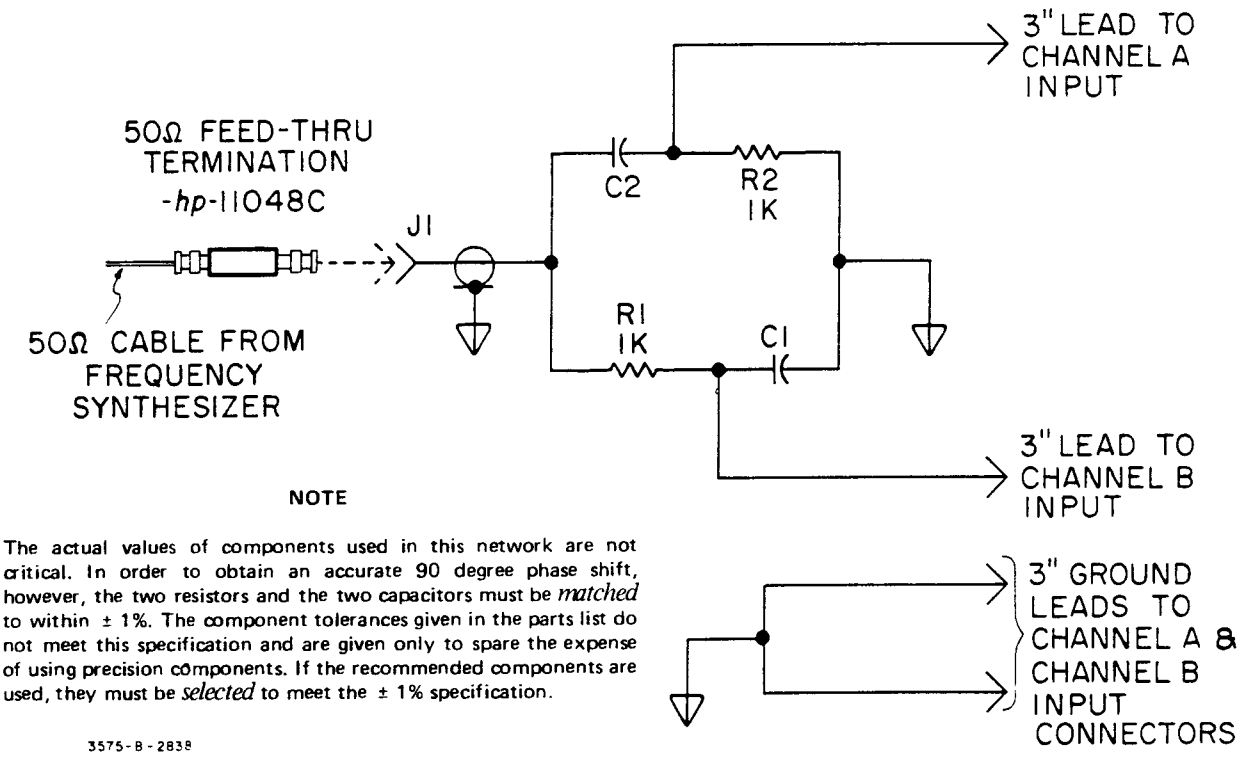
DISPLAY ..... PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE ... Set to lowest applicable range.
PHASE REFERENCE ..... A

f. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms). Set the frequency controls to provide the desired frequency.

*NOTE*

*Refer to the Phase Accuracy specification listing in Table 1-1 (Section I) to determine the Phase error tolerance for the corresponding input levels and frequency. Add ± 0.3 degrees to phase error tolerances to allow for panel meter error.*

g. The phase reading should be + 90 degrees or - 90 degrees ± tolerances listed in Table 1-1. Add ± 0.3 degrees to phase error tolerances to allow for panel meter error. Due to the response of the R/C network, the input levels will vary with frequency. Use the 3575A amplitude functions to measure the input levels and use the lower level to determine the phase accuracy specification.




**NOTE**

The actual values of components used in this network are not critical. In order to obtain an accurate 90 degree phase shift, however, the two resistors and the two capacitors must be *matched* to within ± 1%. The component tolerances given in the parts list do not meet this specification and are given only to spare the expense of using precision components. If the recommended components are used, they must be *selected* to meet the ± 1% specification.

3575-B-2838

**Parts List.**

| Designator | Description | -hp- Part No. | Frequency |
|---|---|---|---|
| C1, C2 | C: fxd mica 10,000 pF 10 % 300 V | 0140-0171 | 100 Hz - 1 MHz |
| C1, C2 | C: fxd mica 100 pF 2 % 300 V | 0140-0176 | 1 MHz - 13 MHz |
| J1 | Connector: BNC female | 1250-0083 | --- |
| R1, R2 | R: fxd film 1.02 kΩ 1 % 1/4 W | 0698-4615 | 100 Hz - 13 MHz |

**Figure 5-4. R/C Phase Shift Network.**

# PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 3575A
Gain-Phase Meter
Serial No._____

Tests Performed By _____

Date _____

## PANEL METER ACCURACY CHECK

| Attenuator Setting | DVM Reading | Panel Meter Reading |
|---|---|---|
| 0 dB | ____ mV | ____ dB |
| 80 dB | ____ mV | ____ dB |
| 80 dB | ____ mV | ____ dB |
| 0dB | ____ mV | ____ deg. |
| 0 dB | ____ V | ____ deg. |

Test Limit: ± 0.3 dB, ± 0.3 deg.

## AMPLITUDE AND PHASE ACCURACY CHECKS

| Input Frequency | Variable Attenuator | B (dBV) | A OR B (dBV) | A (dBV) | B/A (+ or - dB) | B/A (+ or - dB) | B/A (+ or - dB) | Phase (0°) | Phase (0° or 180°) | Phase (180°) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 Hz | 0 dB | _____ | +6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 1 Hz | 30 dB | _____ | - 24.0 ± 1.3 | _____ | _____ | 30.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 1 Hz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.3 | _____ | _____ | ± 1.3 | _____ |
| 1 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ± 2.3 | _____ |
| 1 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ------- | _____ |
| 1 Hz | 60 dB | _____ | - 54.0 ± 1.3 | _____ | _____ | 60.0 ± 1.8 | _____ | _____ | ± 5.3 | _____ |
| 1 Hz | 70 dB | _____ | - 64.0 ± 1.3 | _____ | _____ | 70.0 ± 1.8 | _____ | _____ | ------- | _____ |
| 1 Hz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ------- | _____ |
| 10 Hz | 0 dB | _____ | +6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 10 Hz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 10 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ± 1.3 | _____ |
| 10 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ------- | _____ |
| 10 Hz | 60 dB | _____ | - 54.0 ± 1.3 | _____ | _____ | 60.0 ± 1.8 | _____ | _____ | ± 2.3 | _____ |
| 10 Hz | 70 dB | _____ | - 64.0 ± 1.3 | _____ | _____ | 70.0 ± 1.8 | _____ | _____ | ± 5.3 | _____ |
| 10 Hz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 200 Hz | 0 dB | _____ | +6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 200 Hz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 200 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ± 1.3 | _____ |
| 200 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ------- | _____ |
| 200 Hz | 60 dB | _____ | - 54.0 ± 1.3 | _____ | _____ | 60.0 ± 1.8 | _____ | _____ | ± 2.3 | _____ |

## PERFORMANCE CHECK TEST CARD (Cont'd)

AMPLITUDE AND PHASE ACCURACY CHECKS (Cont'd)

| Input Frequency | Variable Attenuator | B (dBV) | A OR B (dBV) | A (dBV) | B/A (+ or - dB) | B/A (+ or - dB) | B/A (+ or - dB) | Phase ($0^o$) | Phase ($0^o$ or $180^o$) | Phase ($180^o$) |
|---|---|---|---|---|---|---|---|---|---|---|
| 200Hz | 70 dB | _____ | - 64.0 ± 1.3 | _____ | _____ | 70.0 ± 1.8 | _____ | _____ | ± 5.3 | _____ |
| 200 Hz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 500 Hz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 500 Hz | 30 dB | _____ | - 24.0 ± 1.3 | _____ | _____ | 30.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 500 Hz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.3 | _____ | _____ | ± 1.3 | _____ |
| 500 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ± 1.3 | _____ |
| 500 Hz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ------- | _____ |
| 2 kHz | 60 dB | _____ | - 54.0 ± 1.3 | _____ | _____ | 60.0 ± 1.8 | _____ | _____ | ± 2.3 | _____ |
| 5 kHz | 70 dB | _____ | - 64.0 ± 1.3 | _____ | _____ | 70.0 ± 1.8 | _____ | _____ | ± 5.3 | _____ |
| 20 kHz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 0.8 | _____ |
| 50 kHz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 1.3 | _____ |
| 50 kHz | 30 dB | _____ | - 24.0 ± 1.3 | _____ | _____ | 30.0 ± 1.3 | _____ | _____ | ± 5.3 | _____ |
| 50 kHz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.3 | _____ | _____ | ± 5.3 | _____ |
| 50 kHz | 60 dB | _____ | - 54.0 ± 1.3 | _____ | _____ | 60.0 ± 1.8 | _____ | _____ | ± 10.3 | _____ |
| 50 kHz | 60 dB | _____ | - 54.0 ± 2.3 | _____ | _____ | 60.0 ± 2.8 | _____ | | ------- | |
| 50 kHz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 100 kHz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 1.3 | _____ |
| 100 kHz | 50 dB | _____ | - 44.0 ± 1.3 | _____ | _____ | 50.0 ± 1.8 | _____ | _____ | ± 5.3 | _____ |
| 100 kHz | 70 dB | _____ | - 64.0 ± 1.3 | _____ | _____ | 70.0 ± 1.8 | _____ | _____ | ± 10.3 | _____ |
| 200 kHz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 2.3 | _____ |
| 200 kHz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 1 MHz | 0 dB | _____ | + 6.0 ± 1.3 | _____ | _____ | 00.0 ± 1.3 | _____ | _____ | ± 5.3 | _____ |
| 1 MHz | 30 dB | _____ | - 24.0 ± 2.3 | _____ | _____ | 30.0 ± 2.8 | _____ | _____ | ------- | _____ |
| 1 MHz | 40 dB | _____ | - 34.0 ± 1.3 | _____ | _____ | 40.0 ± 1.8 | _____ | _____ | ± 10.3 | _____ |
| 1 MHz | 50 dB | _____ | - 44.0 ± 2.3 | _____ | _____ | 50.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 1 MHz | 60 dB | _____ | - 54.0 ± 2.3 | _____ | _____ | 60.0 ± 2.8 | _____ | _____ | ± 10.3 | _____ |
| 1 MHz | 80 dB | _____ | - 74.0 ± 2.3 | _____ | _____ | 80.0 ± 2.8 | _____ | _____ | ± 20.3 | _____ |
| 2 MHz | 0 dB | _____ | + 6.0 ± 2.3 | _____ | _____ | 00.0 ± 2.3 | _____ | _____ | ± 5.3 | _____ |
| 2 MHz | 50 dB | _____ | - 44.0 ± 2.3 | _____ | _____ | 50.0 ± 3.3 | _____ | _____ | ± 10.3 | _____ |
| 2 MHz | 80 dB | _____ | - 74.0 ± 3.3 | _____ | _____ | 80.0 ± 4.3 | _____ | _____ | ± 20.3 | _____ |
| 5 MHz | 0 dB | _____ | + 6.0 ± 2.3 | _____ | _____ | 00.0 ± 2.3 | _____ | _____ | ± 10.3 | _____ |
| 5 MHz | 40 dB | _____ | - 34.0 ± 2.3 | _____ | _____ | 40.0 ± 3.3 | _____ | _____ | ± 20.3 | _____ |
| 5 MHz | 60 dB | _____ | - 54.0 ± 2.3 | _____ | _____ | 60.0 ± 3.3 | _____ | _____ | ------- | _____ |
| 13 MHz | 0 dB | _____ | + 6.0 ± 2.3 | _____ | _____ | 00.0 ± 2.3 | _____ | _____ | ± 20.3 | _____ |
| 13 MHz | 20 dB | _____ | - 14.0 ± 2.3 | _____ | _____ | 20.0 ± 3.3 | _____ | _____ | ± 20.3 | _____ |
| 13 MHz | 40 dB | _____ | - 34.0 ± 2.3 | _____ | _____ | 40.0 ± 3.3 | _____ | _____ | ------- | _____ |
| 13 MHz | 60 dB | _____ | - 54.0 ± 2.3 | _____ | _____ | 60.0 ± 3.3 | _____ | _____ | ------- | _____ |
| 13 MHz | 80 dB | _____ | - 74.0 ± 3.3 | _____ | _____ | 80.0 ± 4.3 | _____ | _____ | ------- | _____ |

HIGH LEVEL ACCURACY CHECKS

| Frequency | A dBV* | Phase ($0^o$) | B dBV* | Phase ($180^o$) | Phase ($0^o$ OR $180^o$) |
|---|---|---|---|---|---|
| 1 Hz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 10 Hz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 100 Hz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 1 kHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 10 kHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 20 kHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 0.8 deg. |
| 50 kHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 1.3 deg. |
| 200 kHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 2.3 deg. |
| 1 MHz | ____ dBV | ____ deg. | ____ dBV | ____ deg. | ____ ± 5.3 deg. |

*Test Limit A dBV/B dBV: + 26.0 dBV ± 1.3 dBV

SHUNT CAPACITANCE CHECK

| Voltage Range | A Input | B Input |
|---|---|---|
| 0.2 mV - 2 V | ____ deg. | ____ deg. |
| 2 mV - 20 V | ____ deg. | ____ deg. |

Test Limit: $45^o$ or less

## 5-19. ADJUSTMENT PROCEDURES.

5-20. This portion of Section V contains complete adjustment procedures for the Model 3575A Gain-Phase Meter. Included are power supply adjustments (Paragraph 5-25), Panel Meter Adjustments (Paragraph 5-29), Output Filter Zero Adjustments (Paragraph 5-33), Phase Detector Zero Adjustment (Paragraph 5-35), Current Source and Current Sink Adjustments (Paragraph 5-37), Amplitude Offset Adjustment (Paragraph 5-39), Log Amplifier (amplitude accuracy) Adjustments (Paragraph 5-41), Input Attenuator Adjustments (Paragraph 5-43) and High Frequency Phase Adjustments (Paragraph 5-45).

### 5-21. Test Equipment.

5-22. The test equipment required for the adjustments is listed in Table 5-1 and at the beginning of each adjustment procedure. If the recommended model is not available, any instrument that has specifications equal to or better than the required specifications can be used.

### 5-23. Test Point and Adjustment Location.

5-24. Test point and adjustment locations are shown in Figures 5-6 (top view) and 5-7 (panel meter). Figures 5-6 and 5-7 are located on a single fold-out at the end of Section V. All measurement points are either at the Analog Ouptuts or at designated pins of A7P1. Test connector A7P1 is a male PC connector located at the top of the Phase Control Filter Assembly, A7. For convenience when making test connections to A7P1, connect a 2X22-Pin female PC connector (-hp- Part No. 1251-1887) to A7P1 and use the pins of the female connector as test points. If the appropriate PC connector is not available, use the 2X22-Pin PC extender (-hp- 5060-5989) supplied with the instrument. All test measurements should be made with respect to circuit ground which is available at A7P1 pin X or at any point on the instrument chassis. All adjustments are easily accessible with the top cover of the instrument removed. It is not necessary to use PC extenders or remove any of the PC assemblies except when performing the Panel Meter Adjustments, Paragraphs 5-35 through 5-38.

### 5-25. + 12 V Reference Adjustment.

5-26. This adjustment sets the level of the + 12 Vdc power supply which serves as a reference for the other regulated supplies in the instrument.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Connect DC Digital Voltmeter to A7P1 pin 6.

b. Adjust A14R6 for + 12 V ± 3 mVdc.

### 5-27. Power Supply Voltage Checks.

5-28. The purpose of these checks is to verify that the non-adjustable power supply voltages are within design tolerances. If any of the voltages are out of tolerance, refer to the Power Supply Troubleshooting procedure (Paragraph 5-84).

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Measure the dc voltage at each test point listed in Table 5-4. At each test point, the dc voltage should be within the tolerance listed in the table.

**Table 5-4. Power Supply Checks.**

| Test Point | Supply | Tolerance |
|---|---|---|
| A7P1 Pin A | + 2 V (on A3) | + 1.985 V to + 2.015 V |
| A7P1 Pin B | + 2 V (on A4) | + 1.985 V to + 2.015 V |
| A7P1 Pin 3 | + 3.8 V | + 3.700 V to + 3.900 V |
| A7P1 Pin D | - 6 V (A) | - 5.980 V to - 6.020 V |
| A7P1 Pin 4 | - 6 V (B) | - 5.980 V to - 6.020 V |
| A7P1 Pin F | - 12 V | - 11.96 V to - 12.04 V |
| A7P1 Pin Y | - 5.3 V | - 5.200 V to - 5.400 V |
| A7P1 Pin 21 | + 5 V | + 4.980 V to + 5.020 V |

### 5-29. Output Filter Zero Adjustments.

5-30. These adjustments null out any dc offsets introduced by the Output Filters. A9 and A10 (A10 is in Options 001 - 003 only).

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Connect DC Voltmeter to ANALOG OUTPUT 1.

b. Set the 3575A controls as follows:

DISPLAY*. . . . . .PHASE
AMPLITUDE FUNCTION . . . . . .B/A
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . .10 Hz - 100 kHz
PHASE REFERENCE . . . . . A

*Options 001 - 003: Set the AMPLITUDE B/PHASE switch to PHASE.

c. Connect a short clip lead between A9TP1 and A9TP2. This grounds the input to the filter.

d. Adjust A9R27 for 0 V ± 0.05 mV dc at Analog Output 1.

e. Remove the clip lead.

f. Options 001 - 003: Perform the following additional steps.

g. Connect DC Voltmeter to ANALOG OUTPUT 2.

h. Connect a short clip lead between A10TP1 and A10TP2.

i. Adjust A10R27 for 0 V ± 0.05 mV dc at Analog Output 2.

j. Remove the clip lead.

### 5-31. Panel Meter Zero Adjustment (Standard & Options).

5-32. This adjustment zeroes the panel meter in the Standard instrument and both panel meters in the Option instruments. Before proceeding with these adjustments, perform the Panel Meter Accuracy Check (Paragraph 5-9) to determine if adjustments are necessary.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Perform Steps a through h of the Panel Meter Removal procedure (Figure 5-5) to gain access to the panel meter adjustments.

b. Set the 3575A controls as follows:

DISPLAY . . . . . .PHASE
AMPLITUDE FUNCTION . . . . . .B/A
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 10 Hz -100 kHz
PHASE REFERENCE . . . . . A

c. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.

d. Connect a short clip lead between A9TP1 and A9TP2. If the instrument contains two panel meters, also connect a short clip lead between A10TP1 and A10TP2.

e. Adjust A22C4 (inside adjustment) for a Panel Meter display of .000 ± .003. If there are two panel meters, adjust A22C4 in both. Remove short(s) in Step d.

### 5-33. Phase Detector Zero Adjustment.

5-34. This adjustment nulls out any dc offset introduced by the Buffer/Integrator in the Phase Detector.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Connect DC Voltmeter to ANALOG OUTPUT 1.*

b. Set the 3575A controls as follows:

DISPLAY . . . . . .PHASE
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 10 Hz -100 kHz
PHASE REFERENCE . . . . . A

c. Set A5S1 and A6S1 to CAL 1.

d. Adjust A5R31 (ZERO ADJ) for 0 V ± 0.1 mV dc at the Analog Output.

e. Leave A5S1 and A6S1 set to CAL 1 for the following procedure.

### 5-35. Current Source and Current Sink Adjustments.

5-36. These adjustments set the P1 and P2 Current Sources and the X and Y Current Sinks to produce the proper dc levels at the output of the Phase Detector. These are the primary phase accuracy adjustments in the instrument.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450B)

a. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.*

b. Set the 3575A controls as follows:

DISPLAY . . . . . .PHASE
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 10 Hz -100 kHz
PHASE REFERENCE . . . . . A

c. Set A5S1 to CAL 2. Set A6S1 to CAL 1.

d. Adjust A5R40 (P1 ADJ) for -1.8 V ± 0.1 mV dc at the Analog Output.

e. Leave A5S1 set to CAL 2. Set A6S1 to CAL 2.

f. Adjust A6R19 (Y ADJ) for 1 V ± 0.1 mV dc at the Analog Output.

g. Leave A5S1 set to CAL 2. Set A6S1 to CAL 3.

h. Adjust A6R21 (X ADJ) for 1 V ± 0.1 mV dc at the Analog Output.

i. Leave A6S1 set to CAL 3. Set A5S1 to CAL 3.

j. Adjust A5R39 (P2 ADJ) for 0 V ± 0.1 mV dc at the Analog Output.

k. Reset A5S1 and A6S1 to NORMAL (4).

*Options 001 - 003: Connect DC Digital Voltmeter to ANALOG OUTPUT 2. Set the AMPLITUDE B/PHASE switch to PHASE.

### 5-37. Panel Meter/Analog Output Adjustments.

5-38. These adjustments set the panel meter displays to coincide with the analog outputs.

a. Set A5S1 to CAL 2. Set A6S1 to CAL 1.

b. Record reading of phase panel meter (right meter). Reading should be approximately 180°.

c. Set A5S1 to CAL 1. Set A6S1 to CAL 2.

d. Record reading of phase panel meter (right meter) next to recorded reading of Step b.

e. Adjust A22R5 of panel meter for a reading centered between the readings recorded in Steps b and d.

f. For a standard instrument (one panel meter) set A5S1 and A6S1 to NORMAL (4). For Options 001 - 003, perform Steps g through i.

g. A5S1 and A6S1 remain set from Step c. Short A9TP1 and A10TP1 together.

h. Adjust A22R5 of the left panel meter until reading is same as that of the right panel meter.

i. Set A5S1 and A6S1 to NORMAL (4).

### 5-39. Amplitude Offset Adjustment.

5-40. This adjustment sets the dc operating point of the Summing Amplifier in the Function Switching Assembly, A8.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)*
DC Digital Voltmeter (-hp- Model 3450B)
50-Ohm Feed-Thru Termination (-hp- Model 11048C)

a. Connect 50-ohm output of Frequency Synthesizer, terminated in 50-ohm load, to the channel B input of the 3575A. Connect the DC Digital Voltmeter to A7P1 pin 2 (Options 001 - 003: Connect DVM to ANALOG OUTPUT 2).

b. Set the 3575A controls as follows:

DISPLAY** . . . . . AMPLITUDE
AMPLITUDE FUNCTION . . . . . .B
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 10 Hz -100 kHz

c. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms) and frequency to 1 kHz.

d. Record the DVM reading: mV dc.

e. Connect the DC Digital Voltmeter to ANALOG OUTPUT 1.

f. Adjust A8R43 until the DVM indicates the value recorded in Step d ± 0.2 mV dc.

### 5-41. Log Amplifier Adjustments.

5-42. These adjustments set the dc bias, gain and symmetry of the Log Amplifier and Synchronous Rectifier in each input channel. These are the primary amplitude accuracy adjustments in the instrument.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)
DC Digital Voltmeter (-hp- Model 3450A)
Variable Attenuator (-hp- Model 355D)
50-Ohm Feed-Thru Termination (-hp- Model 11048C)

**NOTE**

*The following procedure is performed first for channel B and then again for channel A. The channel B adjustments are located on the channel B Log Converter board, A4. The channel A adjustments are located on the channel A Log Converter board, A3.*

a. Connect the 50-ohm output of the Frequency Synthesizer to the input of the Variable Attenuator (no termination required). Connect the output of the Variable Attenuator, terminated in 50-ohm load, to the Channel B input of the 3575A.

b. Set the 3575A controls as follows:

DISPLAY** . . . . . AMPLITUDE
AMPLITUDE FUNCTION . . . . . .B
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 10 Hz -100 kHz
PHASE REFERENCE . . . . . A

c. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms) and frequency to 10 kHz.

d. Set the Variable Attenuator to 80 dB.

e. Connect DC Digital Voltmeter to A3/A4TP1.

f. Adjust A1/A2 R40 (LOG TP1 ADJ) for a DVM reading of 0 V ± 0.1 V dc.

g. Connect DC Digital Voltmeter to A7P1 pin 22 (Channel B) or A7P1 pin z (Channel A).

*A Test Oscillator such as the -hp- Model 651B can be used in place of the Frequency Synthesizer.
**Options 001 - 003: Set the AMPLITUDE B/PHASE switch to AMPLITUDE B.

h. Adjust R18 (LOG BIAS ADJ) for a DVM reading of 0 V ± 0.2 mV dc.

i. Connect DC digital Voltmeter to ANALOG OUTPUT 1.

j. Adjust R29 (AMPL SYM ADJ) until the *absolute value* of the voltage at Analog Output 1 is *minimum* e.g., - 735 mV dc is less than - 740 mV dc.

k. Set the Variable Attenuator to 70 dB.

l. Center R32 (LOG GAIN ADJ).

m. Adjust R50 (LOG OFFSET ADJ) for - 640 mV ± 0.5 mV dc at Analog Output 1.

n. Set the Variable Attenuator to 0 dB.

o. Adjust R32 (LOG GAIN ADJ) for + 60 mV ± 0.5 mV dc at Analog Output 1.

p. Set the Variable Attenuator to 70 dB.

q. Repeat Steps m through p until optimum adjustment is obtained.

r. Connect the output of the Variable Attenuator, terminated in 50-ohm load, to the channel A input of the 3575A.

s. Set the 3575A AMPLITUDE FUNCTION switch to A.

t. Repeat Steps c through q for channel A. The channel A adjustments are located on A3.

### 5-43. Input Attenuator Adjustments.

5-44. These adjustments compensate the input attenuators so that minimum phase shift is introduced by the attenuators on the 2 mV - 20 V range.

RECOMMENDED TEST EQUIPMENT:
Frequency Synthesizer (-hp- Model 3320B)
Variable Attenuator (-hp- Model 355D)
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
Power Splitter (See Figure 5-1)

a. Connect test equipment as shown in Figure 5-2.

b. Set the 3575A controls as follows:

DISPLAY* ..... PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE.

c. Set the Frequency Synthesizer amplitude to + 25.05 dBm (2 V rms at outputs of Power Splitter) and frequency to 15 kHz.

d. Set the Variable Attenuator to 20 dB.

e. Record the 3575A phase reading:___degrees.

f. Set the Variable Attenuator to 0 dB.

g. Set the Channel B Voltage Range switch to the 2 mV - 20 V position.

h. Adjust A2C2 (ATT ADJ) until the 3575A phase reading is the same as recorded in Step e.

i. Reset the Channel B Voltage Range switch to the 0.2 mV - 2 V position.

j. Reverse the input connections to the 3575A so that the Variable Attenuator output is connected to Channel A and the Power Splitter output is connected to Channel B.

k. Set the Variable Attenuator to 20 dB.

l. Record the 3575A phase reading:___degrees.

m. Set the Variable Attenuator to 0 dB.

n. Set the Channel A Voltage Range switch to the 2 mV - 20 V position.

o. Adjust A1C2 (ATT ADJ) until the 3575A phase reading is the same as recorded in Step l.

p. Reset the Channel A Voltage Range switch to the 0.2 mV - 2 V position.

### 5-45. High Frequency Phase Adjustments.

5-46. The purpose of these adjustments is to minimize the phase shift between the two channels at 13 MHz.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
Power Splitter (See Figure 5-1)

a. Connect the 50-ohm output of the Frequency Synthesizer to the Power Splitter. Connect the outputs of the Power Splitter, terminated in 50-ohm loads, to the 3575A inputs.

*NOTE*

*Connect the 50-Ohm Feed-Thru Terminations directly to the 3575A inputs. The cables from the Power Splitter to*

*the terminations must be of equal length and should be as short as possible.*

b. Set the 3575A controls as follows:

DISPLAY* .....PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE . 1 kHz - 13 MHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE.

c. Set the Frequency Synthesizer amplitude to + 25.05 dBm and frequency to 12.99 MHz.

d. Set A1R4 (PHASE ADJ) fully clockwise.

e. Set A2R4 (PHASE ADJ) fully counter-clockwise.

f. Observe the 3575A phase reading.

g. Adjust A2R4 (PHASE ADJ) until the phase reading is approximately 1/2 the value observed on Step f.

h. Adjust A1R4 (PHASE ADJ) for a phase reading of 00.0 degrees.

i. Reverse the A and B input connections and allow 10 seconds for the phase reading to stabilize.

j. Note the phase reading: ___degrees. If the phase reading is greater than ± 1 degree, perform Steps k through o, if not; proceed to Step p.

k. Adjust A2R4 (PHASE ADJ) until the phase reading is 3/4 the value noted in Step j.

l. Adjust A1R4 (PHASE ADJ) until the phase reading is 1/2 the value noted in Step j.

m. Note the phase reading: degrees. Again reverse the A and B input connections and allow 10 seconds for the phase reading to stabilize.

n. The *absolute value* of the phase reading should be within ± 0.5 degrees of the value noted in Step m. If it is not, split the difference by adjusting A1R4.

o. Repeat Steps m and n until the absolute values of the two readings are equal within ± 0.5 degrees.

p. Note the phase reading: degrees. Set the PHASE REFERENCE switch to the - A positon and allow 10 seconds for the phase reading to stabilize.

q. Again note the phase reading: ___degrees.

r. The *difference* between the readings noted in Steps p and q should be 180 degrees ± 0.5 degrees. If it is not, split the error between the A and - A reference settings by adjusting A1R4. For example, if the A reading is + 1.0 degree and the - A reading is - 179.6 degrees, the error is 0.6 degrees and A1R4 should be adjusted so the - A reading is - 179.3 and the A reading is + 1.3.

### 5-47. High Frequency Log Amplifier Adjustment.

5-48. This adjustment controls the high frequency response of the log amp. See note following Step m.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)
(2) 50-ohm Feed-Thru Terminations (-hp- Model 11048C)
Power Splitter (See Figure 5-1)
22 pin PC Board Extender (-hp- Part No. 5060-5989)

a. Remove the screws from the A3 and A4 assemblies and put the A3 assembly on the extender.

b. Connect the 50-ohm output of the Frequency Synthesizer to the Power Splitter. Connect the outputs of the Power Splitter, terminated in 50-ohm loads, to the 3575A inputs.

NOTE

*Connect the 50-ohm Feed-Thru Terminations directly to the 3575A inputs. The cables from the Power Splitter to the terminations must be of equal length and should be as short as possible.*

c. Set the 3575A controls as follows:

DISPLAY*. . . . . .PHASE
Voltage Range . . . . . 0.2 mV -2 V (both channels)
FREQUENCY RANGE . . . . . 1 kHz -13 MHz
PHASE REFERENCE . . . . . A

d. Set the Frequency Synthesizer amplitude to + 25.05 dBm and frequency to 12.99 MHz.

e. Set the AMPLITUDE FUNCTION to A.

f. Adjust A3L1 for a left panel meter reading of 5.5 to 5.7.

g. Remove the A3 assembly from the extender and install in instrument.

h. Put the A4 assembly on the extender.

*Options 001 - 003: Set the AMPLITUDE B/PHASE switch to PHASE.

i. For a standard instrument (one panel meter) go to Step j. For Options 001 - 003 (two panel meters) go to Step k.

j. Set AMPLITUDE FUNCTION to B and adjust A4L1 for a left panel meter reading of 5.5 to 5.7.

k. With the AMPLITUDE FUNCTION set to A, adjust A4L1 for a right panel meter reading of 5.5 to 5.7.

l. Remove the A4 assembly from the extender and install in the instrument.

m. Replace the A3 and A4 screws.

NOTE

*In earlier instruments A3/A4L1* were factory selected components. They were selected to produce Log A or Log B readings of + 6.0 dB V ± 0.3 dB V with 2 V rms, 13 MHz applied to the input. The typical value range of A3/A4L1* is 0.47 µH to 0.56 µH. If reading is high, change L1* to 0.47 µH; if low, change L1* to 0.56 µH. In some earlier instruments, A3/A4L1* is comprised of a 0.22 µH fixed inductor (-hp-9100-1611) in series with a 0.22 µH to 0.33 µH variable inductor (-hp- 9100-1379) or a single 0.35 µH to 0.55 µH variable inductor (-hp-9100-3294). At the factory, A3/A4L1 is adjusted to produce a Log A or Log B reading of + 6.3 dB V with 2 V rms, 13 MHz applied to the A or B INPUT.*

## 5-49. Factory Selected Components.

5-50. Certain components within the 3575A are individually selected at the factory to compensate for slightly varying circuit parameters. These components are identified by an asterisk (*) in the parts list and schematic diagrams and a typical value is shown. Table 5-5 is a list of the factory selected components, their functions and typical value ranges.

**Table 5-5. Factory Selected Components.**

| Designator | Function | Typical Value Range |
|---|---|---|
| A3/A4R31* | Sets range of Log Amplifier Gain Adjust, A3/A4R32. Increasing R31* increases gain. Normal values range from 3.01 K to 4.99 ; however, values up to 19.1 K can be used. Change R31* only if proper gain adjustment (Paragraph 5-41) cannot be obtained. | 3.01 K to 19.1 K |
| A6 C8* - C13*<br>A7 C8*, C15*<br>A9 C8*, C15*<br>A10 C8*, C15*<br>A11 C6* - C9* | Provision is made for adding these capacitors to permit the use of IC operational amplifiers that require high frequency compensation. | 30 pF to 100 pF (If required) |

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## 5-51. GENERAL SERVICING INFORMATION.

5-52. This portion of Section V contains instructions for removing and replacing assemblies and components, servicing etched circuit boards and cleaning the display window.

### 5-53. Cautions.

5-54. The following precautions should be taken when removing, replacing or handling 3575A assemblies and components. Failure to observe these precautions can result in damage or degraded performance.

a. Turn off the 3575A before removing or replacing a printed-circuit assembly.

b. When replacing Assemblies A1 through A6, be careful not to pinch cables between the assembly cover and the card-nest frame.

c. The following assemblies must be CLEAN HANDLED:

1) Preamplifier Assemblies A1/A2
2) Log Converter Assemblies, A3/A4
3) Phase Control Filter Assembly, A7
4) Output Filter Assemblies, A9/A10

### 5-55. Assembly Removal.

5-56. The following procedures outline the steps required to remove each of the major assemblies within the instrument. Assemblies can be replaced by reversing the procedures.

#### 5-57. Preamplifier Assembly (A1/A2) Removal.

a. Remove the screws that fasten the A1/A2 top cover to the card-nest frame.

b. Unplug cable W3/W4 by pulling upward at A1/A2 J2 (OUTPUT TO LOG CONV).

c. Carefully remove A1/A2 by pulling upward on the tabs at the ends of the A1/A2 top cover.

d. The input cable must be taken out of its slot at the top of the board and output cable disconnected to allow A1/A2 to be mounted on the 22-pin PC extender (-hp-5060-5989) supplied with the instrument. If A1/A2 is to be placed on the extender, first install the extender in the A1/A2 socket. Then place A1/A2 on the extender and reconnect output cable W3/W4.

e. If it is necessary to remove A1/A2 completely, disconnect the input cable from A1/A2. To disconnect the cable, remove the screw that fastens the cable shield to the ground lug and unsolder the center conductor from the stand-off pin.

#### 5-58. Log Converter Assembly (A3/A4) Removal.

a. Remove the six screws that fasten the A3/A4 top cover to the card-nest frame.

b. Unplug cable W3/W4 from the Preamplifier board by pulling upward at A1/A2 J2 (OUTPUT TO LOG CONV).

c. Carefully remove A3/A4 by pulling upward on the tabs at the ends of the A3/A4 top cover.

d. The input and output cables are long enough to allow A3/A4 to be mounted on the 22-pin PC Extender (-hp-5060-5989) supplied with the instrument. If A3/A4 is to be placed on the extender, first install the extender in the A3/A4 socket. Then place A3/A4 on the extender and reconnect input cable W3/W4.

e. If it is necessary to remove A3/A4 completely, remove the screw that fastens the shield of output cable W5/W6 to the A3/A4 top cover and disconnect the cable leads from A3/A4 J2.

#### 5-59. Phase Detector Assembly (A5) Removal.

a. Remove the six screws that fasten the A5 top cover to the card-nest frame.

b. Remove the A6 assembly and carefully unplug cable W7 from the Current Source board at A6J1 (INPUT FROM PHASE DETECTOR).

c. Being careful to avoid straining the other two cables connected to A5, remove A5 by pulling upward on the tabs at the ends of the A5 top cover.

d. The cables going to A5 are long enough to allow A5 to be mounted on the 22-pin Extender (-hp- 5060-5989) supplied with the instrument. If A5 is to be placed on the extender, first install the extender in the A5 socket. Then place A5 on the extender and reconnect cable W7 to the Current Source Board.

e. If it is necessary to remove A5 completely, remove the screws that fasten input cables W5 and W6 to the A5 top cover. Disconnect W5 and W6 from A5 J2 and J3. When reinstalling A5 be sure that the input cable from channel A (A3) is connected to the pins marked A and $\overline{A}$ and the input cable from channel B is connected to the pins marked B and $\overline{B}$.

#### 5-60. Current Source Assembly (A6) Removal.

a. Remove the six screws that fasten the A6 top cover to the card-nest frame.

b. Unplug cable W7 by pulling upward at A6J1 (INPUT FROM PHASE DET).

c. Being careful to avoid straining cable W5 which runs from A3 to A5 across the top of A6, remove A6 by pulling upward on the tabs at the ends of the A6 top cover.

d. Input cable W7 is long enough to allow A6 to be mounted on the 22-pin PC extender (-hp- 5060-5989) supplied with the instrument. If A6 is to be placed on the extender, first install the extender in the A6 socket (route W5 around the extender). Then place A6 on the extender and reconnect input cable, W7.

**5-61. Removal of Assemblies A8 through A11 and A14.**

a. Remove the Retainer Strap (MP 35, Figure 6-1).

b. Remove the board by lifting the extractors at the ends of the board. Note that the extractors are color coded to identify the assembly number. The extractor colors match the corresponding guides on the main frame.

**5-62. Interface Substitution Board, A16A.** The Interface Substitution Board, A16A, is a PC card that is used to make connections between the front panel controls and the Function Switching Assembly (A8) in the absence of the Interface Assembly, A16B (A16B is in Options 002 and 003). When installing A16A, be sure that the side marked "FACE THIS SIDE TOWARD FRONT" is facing the front panel. Reversing A16A will not damage the instrument but will cause the front panel controls to be inoperative.

**5-63. Interface Assembly (A16B - Options 002, 003) Removal.**

a. Remove the two screws that fasten the Interface connector to the rear panel (large Phillips head screws).

b. While supporting A16B with one hand, unplug A19 from A16B by pulling outward on the Interface connector.

c. Remove the A16B board by lifting the extractors at the ends of the board.

d. For troubleshooting, place A16B on the 22-pin PC Extender supplied with the instrument Plug A19 into A16B if remote connections are required.

**5-64. Removing the Front Panel, Panel Meters and A12.** Refer to the procedure outlined in Figure 5-5.

NOTE

*For panel meter/interconnect board combinations in earlier instruments, obtain Service Note 3575A-4, "Original Configuration of panel meter and Interconnect Boards", from your -hp- Sales and Service Office.*

**5-65. Component Replacement.**

5-66. When replacing components in the 3575A, observe the general guidelines listed in Paragraph 5-69. In additon, note the following:

a. The reed relays on the Preamplifier Assemblies, A1 and A2, are of the plug-in type. To remove a reed relay, use a pair of long-nosed pliers and gently lift each end of the relay until it is unplugged.

b. To remove the Hybrid Log Amplifiers, A3/A4 IC1, proceed as follows:

1) Remove the screw that fastens the IC1 heat sink to the A3/A4 top cover.

2) Remove the two nuts located directly below IC1 on the circuit side of the board.

3) Carefully unplug IC1 from its socket.

c. When replacing transistors and IC's, note the lead configuration and position of the defective component and orient the replacement component in the same manner as the original. Dots are provided on the PC boards to show the orientation of IC's. For IC's in the 8-pin circular package, the dot indicates the tab (pin 8) position. For IC's in the dual-in-line package, the dot indicates pin 1.

d. Dots are provided on the PC boards to show the orientation of electrolytic capacitors and diodes. For electrolytic capacitors, the dot indicates the positive lead. For diodes, the dot indicates the cathode lead.

**5-67. Servicing Etched Circuit Boards.**

5-68. The Standard Model 3575A contains 19 printed-circuit (PC) assemblies. The -hp- part number is printed on each assembly for identification. Identical assemblies such as A1/A2, A3/A4 and A9/A10 are interchangeable and have identical part numbers. Refer to Section VI for parts replacement and -hp- part number information.

5-69. The printed-circuit boards in the 3575A are of the plated through type. The electrical connection between two sides of a board is made by a layer of metal plated through the component hole. When servicing printed-circuit boards, observe the following guidelines:

a. Use a low-heat (25 to 30 watts) small-tip soldering iron, and small diameter rosin-core solder.

b. Remove components and clean component holes using a desoldering tool.

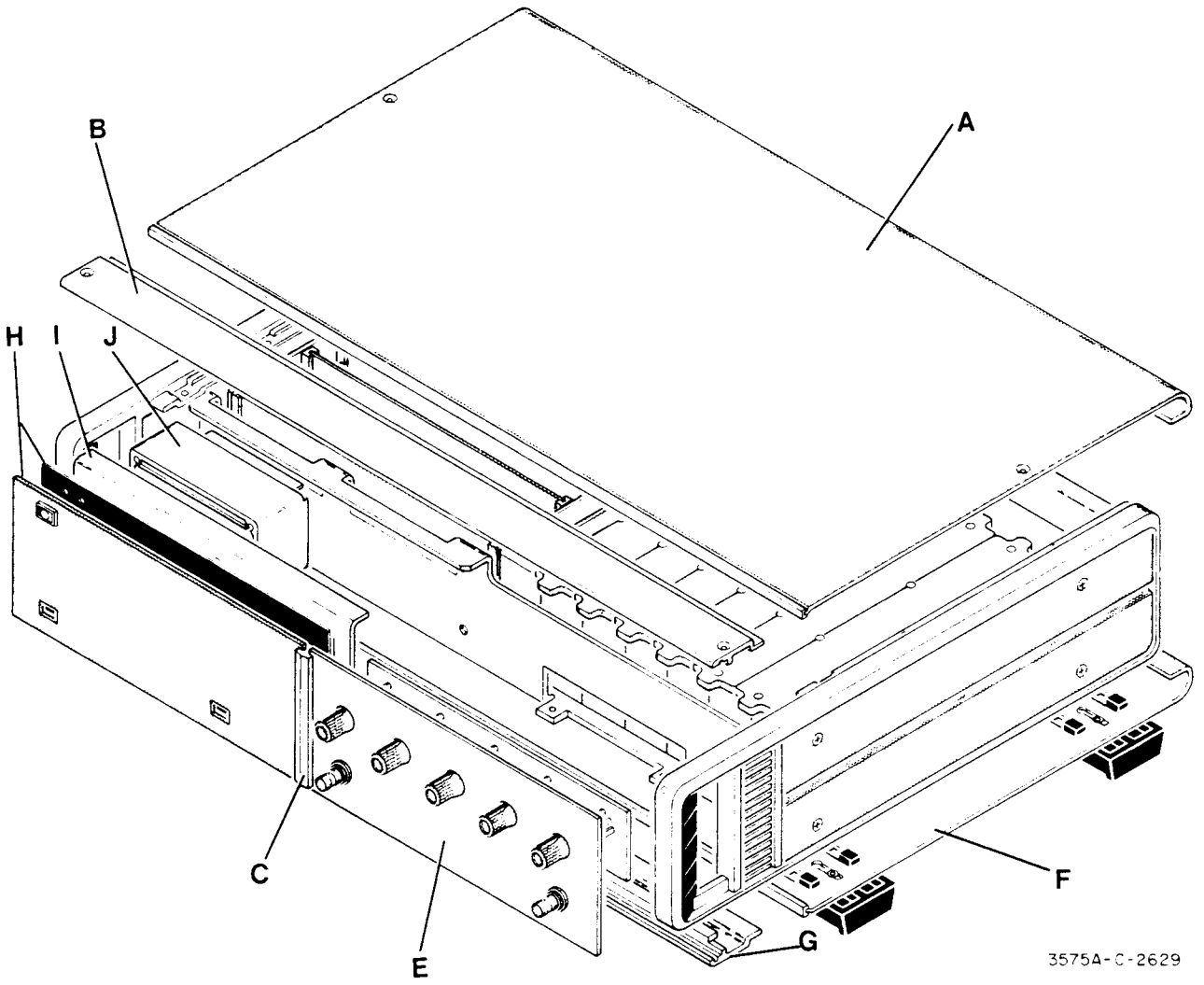
c. Do not overheat the PC connections (pads).

d. To replace components, shape new leads and insert them in lead holes. Reheat connections and apply a small amount of solder as required to insure a good electrical connection.

e. Clean excessive flux from the connection and adjoining area.

**5-70. Cleaning the Display Window.**

5-71. When cleaning the Display Window, do not use harsh chemicals or abrasives. Use a soft cloth along with clear water or a diluted window cleaner.




a. Remove the Top Cover.

b. Remove the Top Panel-Trim.

c. Remove the Center Trim (slide upward).

d. If the Front Panel is to be removed, perform Step e; if not, proceed to Step f.

e. Pull upward on the Front Panel to unplug the Front Panel Switching Assembly. Allow the Front Panel to tilt toward you and rest on the bench with the rear of the panel facing upward. If the Front Panel Switching Assembly is to be removed, proceed as follows:

1) Remove the knobs from the front panel controls.

2) Remove the five nuts that fasten the control switches to the Front Panel.

f. Remove the Bottom Cover.

g. Remove the Bottom Panel-Trim.

h. Remove the red Display Window and the black Display Mask.

i. Remove the aluminum Display Panel (4 straight-slot screws).

j. The Panel Meter(s) can now be unplugged and removed from the instrument. When removing or replacing a Panel Meter, support A12 to prevent it from being damaged due to strain.

k. Once the Panel Meters are removed, the A12 board can be removed by removing the Retainer Strap (MP35, Figure 6-1) and lifting the extractors at the ends of the board.

l. To gain access to boards within the Panel Meter, proceed as follows:

1) Unplug the Panel Meter as outlined in Step j.

2) Slide the Panel Meter out of its dust cover.

3) For Panel Meter troubleshooting, place A12 on a 22-pin PC Extender and plug the Panel Meter into A12.

**Figure 5-5. Removing the Front Panel, Panel Meters and A12.**

## 5-72. TROUBLESHOOTING.

5-73. This portion of Section V contains information and procedures designed to assist in the isolation of malfunctions. The information presented is based on a systematic analysis of the instrument circuits and, if followed, will minimize troubleshooting time.

### 5-74. Guidelines.

5-75. Before troubleshooting the 3575A, observe the following guidelines:

a. Perform the adjustments outlined in Paragraphs 5-25 through 5-48. Some apparent malfunctions can be corrected by these adjustments or the inability to obtain correct adjustment will often reveal the source of trouble.

b. Check the power supplies (Paragraph 5-27) before troubleshooting other sections.

c. Check for burned or loose components, loose connections or any other obvious condition that might be a source of trouble.

### 5-76. Symptoms.

5-77. Obtain as many front panel symptoms as possible. Check the performance of the 3575A and obtain the following failure information:

a. Does the trouble affect amplitude readings? If yes, disregard phase and refer to the Amplitude Troubleshooting Tree (Figure 5-8). The Amplitude Troubleshooting Tree will help isolate the trouble to a stage or component or will lead to the Digital Panel Meter Troubleshooting Tree (Figure 5-9).

b. Does the trouble affect *phase* readings *only*? If yes, refer to the Phase Troubleshooting Tree (Figure 5-10). The Phase Troubleshooting Tree will help isolate the trouble to a stage or component or will lead to the Phase Logic Troubleshooting Tree (Figure 5-11).

### 5-78. Troubleshooting Trees.

5-79. The four troubleshooting trees, Figure 5-8 through 5-11, are located on fold-outs at the end of this section. When entering a troubleshooting tree, always start at the point labeled "START". Do not attempt to start in the middle of a tree. Checks outlined in each troubleshooting tree will lead to another troubleshooting tree or to one of the following:

"Probable Cause"
"Recheck Symptoms"

**5-80. "Probable Cause."** The "Probable Cause" information only indicates the most likely failure areas and designated components are not necessarily the exact cause of trouble. The "Probable Cause" information should be used in conjunction with the voltages and waveforms on the schematic diagrams to further pinpoint the source of trouble.

**5-81. "Recheck Symptoms."** The "Recheck Symptoms" blocks indicate that preceeding checks do not reveal any specific malfunction. When confronted with a "Recheck Symptom" block, recheck the performance of the instrument to verify that the original symptom is still present. If the original symptom persists, repeat the checks outlined in the troubleshooting trees while watching for marginal indications. If the trouble still cannot be localized, troubleshoot using the voltages and waveforms on the schematic diagrams. Contact the nearest -hp- Service Office or Customer Service facility if assistance is required.

### 5-82. Measurement Conditions.

5-83. The voltages and waveforms shown on the schematics and troubleshooting trees were obtained with a 1 V rms (+6 dBV), 1 kHz sine wave applied to both inputs. If symptoms do not appear with 2 V rms, 1 kHz inputs, troubleshoot using inputs that produce symptoms. Keep the input level as high as possible and the input frequency as close to 1 kHz as possible. Note that some of the waveshapes and voltages may differ when inputs other than 2 V rms, 1 kHz are used.

### 5-84. Control Settings.

5-85. When using the troubleshooting trees with 2 V rms, 1 kHz inputs, the 3575A controls should be set as follows:

DISPLAY ..... AMPLITUDE
(for amplitude problem)
DISPLAY ..... PHASE
(for phase problem)
AMPLITUDE FUNCTION ..... A
(or as specified)
Voltage Range ..... 0.2 mV - 2 V
(both channels)
FREQUNECY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... + A
(or as specified)

### 5-86. Power Supply Troubleshooting.

5-87. The 3575A contains six major power supplies that furnish regulated voltage to the various assemblies throughout the instrument. The raw supplies are located on the Power Supply Mother Board, A15, and the regulator circuits for these supplies are located on the Power Supply Assembly, A14. In addition, the Log Converter Assemblies, A3 and A4, contain separate regulator circuits which supply + 2 Vdc to the Hybrid Log Amplifiers. The + 2 V regulators receive preregulated voltage from the + 3.8 Vdc supply on A14.

5-88. Before troubleshooting the 3575A, perform the + 12 V Reference Adjustment (Paragraph 5-25) and check the power supply voltages as outlined in Paragraph 5-28.

Additional checks can be performed using the power supply data listed in Table 5-6. If any of the supply voltages are out of tolerance, troubleshoot the corresponding power supply or regulator circuit by checking for the dc voltages shown on the schematics.

*NOTE*

*All of the regulators on A14 are directly or indirectly referenced to + 12 Vdc. The + 12 Vdc reference must, therefore, be properly adjusted to establish the accuracy of the other supply voltages. In addition, all of the IC regulators on A14 use + 12 Vdc and - 12 Vdc and a failure in either of these supplies can affect the other supply voltages.*

**5-89. No Load Checks.** The Power Supply Assembly, A14, is equipped with separate input and output connectors to permit the supplies to be checked under no load conditions. The 2X10-pin connector on the left-hand side of A14 receives unregulated inputs from the raw supplies on A15. The 12-pin connector on the right-hand side of A14 outputs the regulated voltages from A14 to the main Mother Board Assembly, A17.

5-90. To check the supplies under no load conditions, proceed as follows:

a. Place A14 on a 2X10-pin PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

b. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

c. Using a DC voltmeter, measure the regulated output voltages at pins 4 through 10 of the 12-pin connector on A14. The dc voltages should be as follows:

| Pin | Voltage |
|---|---|
| 4 | + 5 V ± 0.02 Vdc |
| 5 | - 5.3 V ± 0.1 Vdc |
| 6 | - 6 V ± 0.02 Vdc |
| 7 | - 6 V ± 0.02 Vdc |
| 8 | + 3.8 V ± 0.1 Vdc |
| 9 | - 12 V ± 0.04 Vdc |
| 10 | + 12 V ± 3 mVdc * |

* Adjustable

**5-91. Troubleshooting the + 12 V and - 12 V Supplies.** Due to the interaction between the + 12 V and - 12 V supplies, it is sometimes difficult to isolate failures in these supplies. If difficulty is encountered, check suspected components with an ohmeter or transistor checker, replace A14IC1 and IC2 or isolate the trouble using an external dc source as outlined in the following procedure:

RECOMMENDED EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)
± 12 Vdc Variable Power Supply (-hp- Model 467A)

a. Check to be sure that the raw supply voltages are present at XA14A pins 9 (+ 19 Vdc) and B (- 19 Vdc).

b. Disconnect one end of A14R1.

c. Place A14 on a 2X10 PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

d. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

e. Connect the DC Digital Voltmeter to pin 9 of the 12-pin connector on A14.

f. Apply + 12 Vdc from an external power supply to pin 10 of the 12-pin connector on A14.

g. The DVM reading should not be - 12 V dc. If - 12 V dc is present, leave the external power supply connected and troubleshoot the + 12 V regulator circuit by checking for the dc voltages shown on Schematic No. 8. If - 12 V dc is not present, perform the following steps.

h. Disconnect the external power supply and reconnect A14R1. Disconnect one end of A14R8.

i. Connect the DVM to pin 10 of the 12-pin connector on A14.

j. Apply - 12 Vdc from an external power supply to pin 9 of the 12-pin connector on A14.

k. The DVM reading should now be + 12 Vdc. If + 12 Vdc is present, leave the external power supply connected and troubleshoot the - 12 V regulator circuit by checking for the dc voltages shown on the schematics. If + 12 Vdc is not present, there are failures in both regulator circuits.

**Table 5-6. Power Supply Ratings.**

| Power Supply | Test Point | Voltage Limit | Ripple (p-p) | Line Regulation (115 V/230 V ± 10 %) | Nominal Load Current |
|---|---|---|---|---|---|
| + 12 V * | A7P1 Pin 6 | + 11.997 V to + 12.003 V | 1 mV | ± 1 mV | 180 mA |
| - 12 V | A7P1 Pin F | - 11.960 V to - 12.040 V | 1 mV | ± 1 mV | 180 mA |
| - 6 V (A) | A7P1 Pin D | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| - 6 V (B) | A7P1 Pin 4 | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| + 5 V | A7P1 Pin 21 | + 4.980 V to + 5.020 V | 1 mV | ± 0.1 mV | 1 A ** |
| - 5.3 V | A7P1 Pin Y | - 5.200 V to - 5.400 V | 1 mV | ± 0.1 mV | 350 mA |
| + 3.8 V | A7P1 Pin 3 | + 3.700 V to + 3.900 V | 3 mV | ± 0.2 mV | 300 mA |

* Adjustable (A14R6)
** Load increases to 1.5 A in Option 001 instruments and to 2 A in Option 002, 003 instruments.

Additional checks can be performed using the power supply data listed in Table 5-6. If any of the supply voltages are out of tolerance, troubleshoot the corresponding power supply or regulator circuit by checking for the dc voltages shown on the schematics.

*NOTE*

*All of the regulators on A14 are directly or indirectly referenced to + 12 Vdc. The + 12 Vdc reference must, therefore, be properly adjusted to establish the accuracy of the other supply voltages. In addition, all of the IC regulators on A14 use + 12 Vdc and - 12 Vdc and a failure in either of these supplies can affect the other supply voltages.*

**5-89. No Load Checks.** The Power Supply Assembly, A14, is equipped with separate input and output connectors to permit the supplies to be checked under no load conditions. The 2X10-pin connector on the left-hand side of A14 receives unregulated inputs from the raw supplies on A15. The 12-pin connector on the right-hand side of A14 outputs the regulated voltages from A14 to the main Mother Board Assembly, A17.

5-90. To check the supplies under no load conditions, proceed as follows:

a. Place A14 on a 2X10-pin PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

b. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

c. Using a DC voltmeter, measure the regulated output voltages at pins 4 through 10 of the 12-pin connector on A14. The dc voltages should be as follows:

| Pin | Voltage |
|---|---|
| 4 | + 5 V ± 0.02 Vdc |
| 5 | - 5.3 V ± 0.1 Vdc |
| 6 | - 6 V ± 0.02 Vdc |
| 7 | - 6 V ± 0.02 Vdc |
| 8 | + 3.8 V ± 0.1 Vdc |
| 9 | - 12 V ± 0.04 Vdc |
| 10 | + 12 V ± 3 mVdc * |

* Adjustable

**5-91. Troubleshooting the + 12 V and - 12 V Supplies.** Due to the interaction between the + 12 V and - 12 V supplies, it is sometimes difficult to isolate failures in these supplies. If difficulty is encountered, check suspected components with an ohmeter or transistor checker, replace A14IC1 and IC2 or isolate the trouble using an external dc source as outlined in the following procedure:

RECOMMENDED EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)
± 12 Vdc Variable Power Supply (-hp- Model 467A)

a. Check to be sure that the raw supply voltages are present at XA14A pins 9 (+ 19 Vdc) and B (- 19 Vdc).

b. Disconnect one end of A14R1.

c. Place A14 on a 2X10 PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

d. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

e. Connect the DC Digital Voltmeter to pin 9 of the 12-pin connector on A14.

f. Apply + 12 Vdc from an external power supply to pin 10 of the 12-pin connector on A14.

g. The DVM reading should not be - 12 V dc. If - 12 V dc is present, leave the external power supply connected and troubleshoot the + 12 V regulator circuit by checking for the dc voltages shown on Schematic No. 8. If - 12 V dc is not present, perform the following steps.

h. Disconnect the external power supply and reconnect A14R1. Disconnect one end of A14R8.

i. Connect the DVM to pin 10 of the 12-pin connector on A14.

j. Apply - 12 Vdc from an external power supply to pin 9 of the 12-pin connector on A14.

k. The DVM reading should now be + 12 Vdc. If + 12 Vdc is present, leave the external power supply connected and troubleshoot the - 12 V regulator circuit by checking for the dc voltages shown on the schematics. If + 12 Vdc is not present, there are failures in both regulator circuits.

**Table 5-6. Power Supply Ratings.**

| Power Supply | Test Point | Voltage Limit | Ripple (p-p) | Line Regulation (115 V/230 V ± 10 %) | Nominal Load Current |
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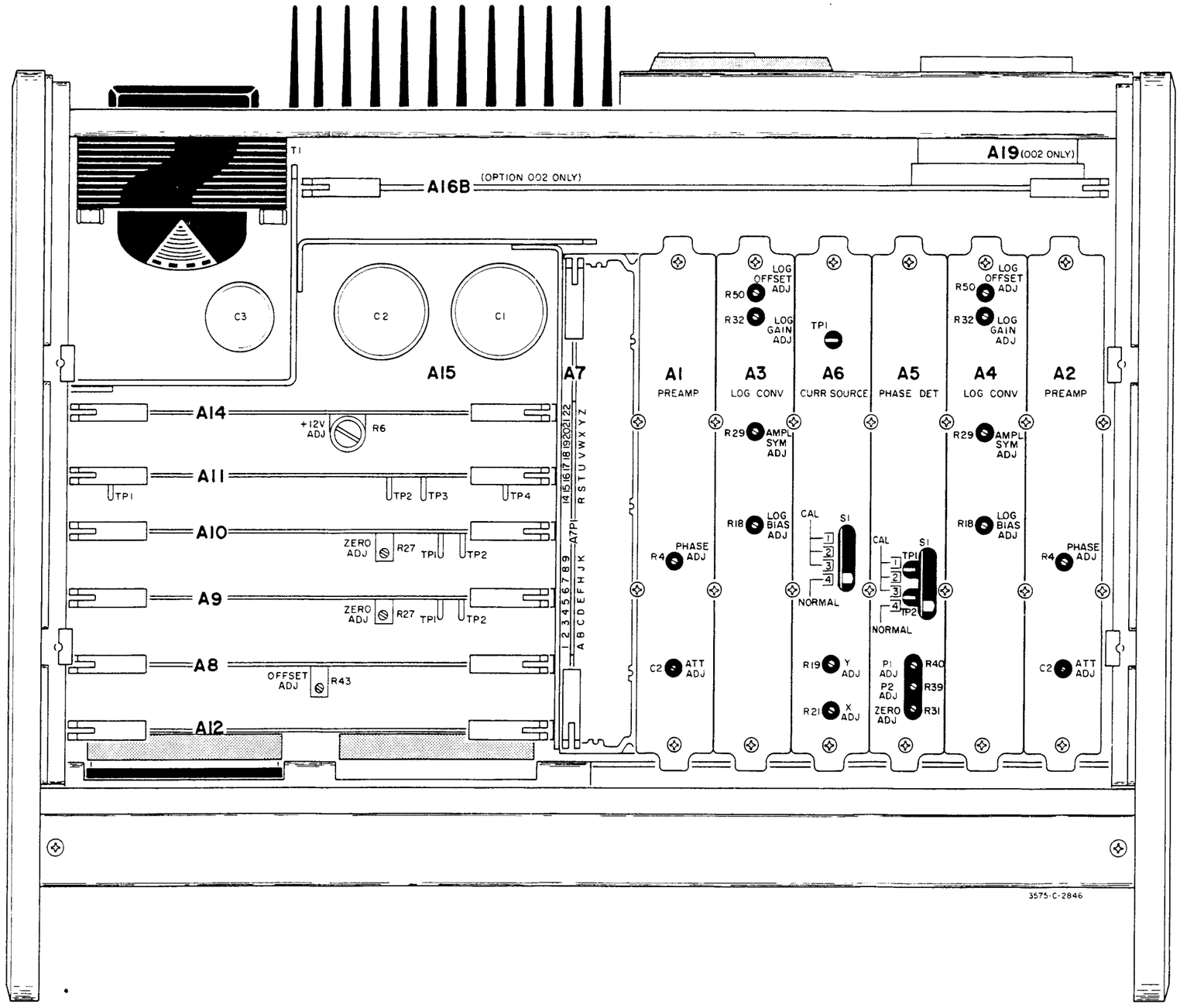
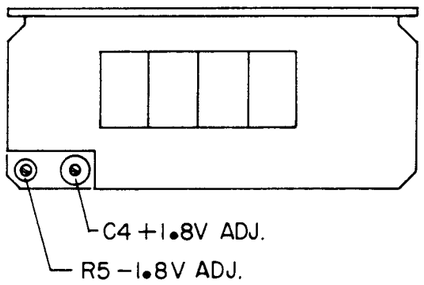
| - 6 V (A) | A7P1 Pin D | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| - 6 V (B) | A7P1 Pin 4 | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| + 5 V | A7P1 Pin 21 | + 4.980 V to + 5.020 V | 1 mV | ± 0.1 mV | 1 A ** |
| - 5.3 V | A7P1 Pin Y | - 5.200 V to - 5.400 V | 1 mV | ± 0.1 mV | 350 mA |
| + 3.8 V | A7P1 Pin 3 | + 3.700 V to + 3.900 V | 3 mV | ± 0.2 mV | 300 mA |

* Adjustable (A14R6)
** Load increases to 1.5 A in Option 001 instruments and to 2 A in Option 002, 003 instruments.

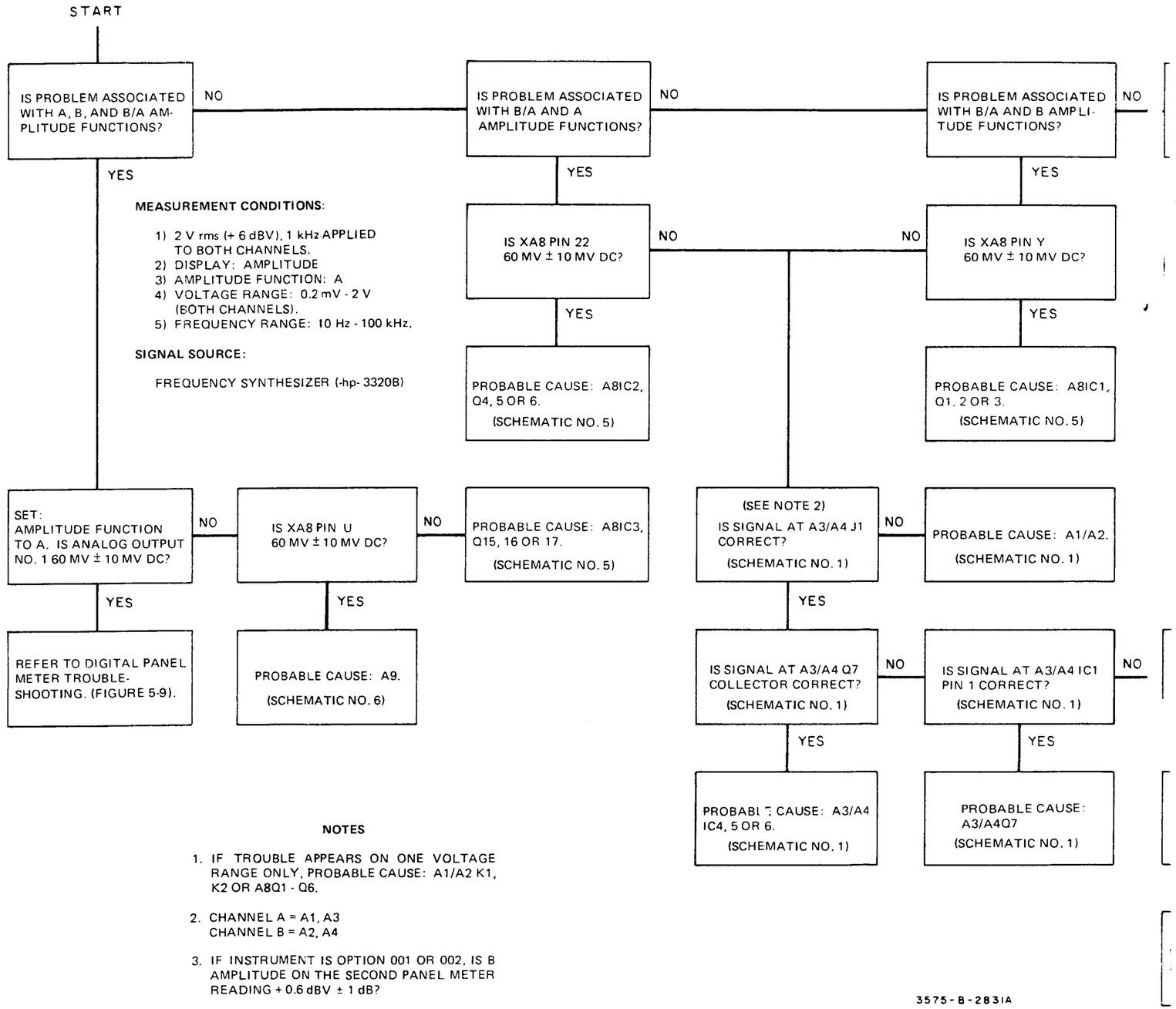

T1
A19 (002 ONLY)
A16B (OPTION 002 ONLY)
C3
C2
C1
A15
A7
A14
+12V ADJ
R6
A11
TP1
TP2
TP3
TP4
A10
ZERO ADJ
R27
TP1
TP2
A9
ZERO ADJ
R27
TP1
TP2
A8
OFFSET ADJ
R43
A12
14 15 16 17 18 19 20 21 22
R S T U V W X Y Z
A7P1
1 2 3 4 5 6 7 8 9
A B C D E F H J K
A1 PREAMP
A3 LOG CONV
A6 CURR SOURCE
A5 PHASE DET
A4 LOG CONV
A2 PREAMP
R50 LOG OFFSET ADJ
R32 LOG GAIN ADJ
TP1
R29 AMPL SYM ADJ
R18 LOG BIAS ADJ
R4 PHASE ADJ
C2 ATT ADJ
CAL
S1
1
2
3
4
NORMAL
TP1
TP2
R19 Y ADJ
R21 X ADJ
P1 ADJ
P2 ADJ
ZERO ADJ
R40
R39
R31
3575-C-2846

Rev. B




3575B 4045

Figure 5-6. Location of Main Assemblies and Adjustments.
Figure 5-7. Location of Panel Meter Adjustments.


START
IS PROBLEM ASSOCIATED WITH A, B, AND B/A AMPLITUDE FUNCTIONS?
NO
YES
IS PROBLEM ASSOCIATED WITH B/A AND A AMPLITUDE FUNCTIONS?
NO
YES
IS XA8 PIN 22 60 MV ± 10 MV DC?
NO
YES
PROBABLE CAUSE: A8IC2, Q4, 5 OR 6. (SCHEMATIC NO. 5)
IS PROBLEM ASSOCIATED WITH B/A AND B AMPLITUDE FUNCTIONS?
NO
YES
IS XA8 PIN Y 60 MV ± 10 MV DC?
NO
YES
PROBABLE CAUSE: A8IC1, Q1, 2 OR 3. (SCHEMATIC NO. 5)
MEASUREMENT CONDITIONS:
1) 2 V rms (+ 6 dBV), 1 kHz APPLIED TO BOTH CHANNELS.
2) DISPLAY: AMPLITUDE
3) AMPLITUDE FUNCTION: A
4) VOLTAGE RANGE: 0.2 mV - 2 V (BOTH CHANNELS).
5) FREQUENCY RANGE: 10 Hz - 100 kHz.
SIGNAL SOURCE:
FREQUENCY SYNTHESIZER (-hp- 3320B)
SET: AMPLITUDE FUNCTION TO A. IS ANALOG OUTPUT NO. 1 60 MV ± 10 MV DC?
NO
YES
REFER TO DIGITAL PANEL METER TROUBLE-SHOOTING. (FIGURE 5-9).
IS XA8 PIN U 60 MV ± 10 MV DC?
NO
YES
PROBABLE CAUSE: A9. (SCHEMATIC NO. 6)
PROBABLE CAUSE: A8IC3, Q15, 16 OR 17. (SCHEMATIC NO. 5)
(SEE NOTE 2) IS SIGNAL AT A3/A4 J1 CORRECT? (SCHEMATIC NO. 1)
NO
YES
PROBABLE CAUSE: A1/A2. (SCHEMATIC NO. 1)
IS SIGNAL AT A3/A4 Q7 COLLECTOR CORRECT? (SCHEMATIC NO. 1)
NO
YES
PROBABLE CAUSE: A3/A4 IC4, 5 OR 6. (SCHEMATIC NO. 1)
IS SIGNAL AT A3/A4 IC1 PIN 1 CORRECT? (SCHEMATIC NO. 1)
NO
YES
PROBABLE CAUSE: A3/A4Q7 (SCHEMATIC NO. 1)
NOTES
1. IF TROUBLE APPEARS ON ONE VOLTAGE RANGE ONLY, PROBABLE CAUSE: A1/A2 K1, K2 OR A8Q1 - Q6.
2. CHANNEL A = A1, A3
CHANNEL B = A2, A4
3. IF INSTRUMENT IS OPTION 001 OR 002, IS B AMPLITUDE ON THE SECOND PANEL METER READING + 0.6 dBV ± 1 dB?
3575-B-2831A

START

ROBLEM ASSOCIATED H A, B, AND B/A AM- TUDE FUNCTIONS?

NO

YES

**MEASUREMENT CONDITIONS:**

1) 2 V rms (+ 6 dBV), 1 kHz APPLIED TO BOTH CHANNELS.
2) DISPLAY: AMPLITUDE
3) AMPLITUDE FUNCTION: A
4) VOLTAGE RANGE: 0.2 mV - 2 V (BOTH CHANNELS).
5) FREQUENCY RANGE: 10 Hz - 100 kHz.

**SIGNAL SOURCE:**

FREQUENCY SYNTHESIZER (-hp- 3320B)

IS PROBLEM ASSOCIATED WITH B/A AND A AMPLITUDE FUNCTIONS?

NO

YES

IS XA8 PIN 22 60 MV ± 10 MV DC?

NO

YES

PROBABLE CAUSE: A8IC2, Q4, 5 OR 6.
(SCHEMATIC NO. 5)

IS PROBLEM ASSOCIATED WITH B/A AND B AMPLI- TUDE FUNCTIONS?

NO

YES

IS XA8 PIN Y 60 MV ± 10 MV DC?

NO

YES

PROBABLE CAUSE: A8IC1, Q1. 2 OR 3.
(SCHEMATIC NO. 5)

IS PROBLEM ASSOCIATED WITH A AMPLITUDE FUNCTION ONLY?

NO

YES

PROBABLE CAUSE: A8Q9, 10, 11 OR 12.
(SCHEMATIC NO. 5)

IS PROBLEM ASSOCIATED WITH A AND B BUT NOT B/A AMPLITUDE FUNCTIONS?

NO

YES

PROBABLE CAUSE: A8Q13 OR 14.
(SCHEMATIC NO. 5)

SEE NOTE 3

NO

RECHECK SYMPTOMS

YES

PROBABLE CAUSE: A8Q16.
(SCHEMATIC NO. 5)

LITUDE FUNCTION IS ANALOG OUTPUT 60 MV ± 10 MV DC?

NO

YES

ER TO DIGITAL PANEL ER TROUBLE- TING. (FIGURE 5-9).

IS XA8 PIN U 60 MV ± 10 MV DC?

NO

YES

PROBABLE CAUSE: A9.
(SCHEMATIC NO. 6)

PROBABLE CAUSE: A8IC3, Q15, 16 OR 17.
(SCHEMATIC NO. 5)

(SEE NOTE 2)
IS SIGNAL AT A3/A4 J1 CORRECT?
(SCHEMATIC NO. 1)

NO

PROBABLE CAUSE: A1/A2.
(SCHEMATIC NO. 1)

YES

IS SIGNAL AT A3/A4 Q7 COLLECTOR CORRECT?
(SCHEMATIC NO. 1)

NO

YES

PROBABLE CAUSE: A3/A4 IC4, 5 OR 6.
(SCHEMATIC NO. 1)

IS SIGNAL AT A3/A4 IC1 PIN 1 CORRECT?
(SCHEMATIC NO. 1)

NO

YES

PROBABLE CAUSE: A3/A4Q7
(SCHEMATIC NO. 1)

IS A3/A4 IC1 PIN 4 + 2 V ± 15 MV?

NO

YES

PROBABLE CAUSE: A3/A4 IC3 OR Q10.
(SCHEMATIC NO. 1)

IS A3/A4 IC2 PIN 6 <± 5 V DC?
(SCHEMATIC NO. 1)

NO

YES

PROBABLE CAUSE: A3/A4 IC2
(SCHEMATIC NO. 1)

PROBABLE CAUSE: A3/A4 IC1.
(SCHEMATIC NO. 1)

**NOTES**

1. IF TROUBLE APPEARS ON ONE VOLTAGE RANGE ONLY, PROBABLE CAUSE: A1/A2 K1, K2 OR A8Q1 - Q6.
2. CHANNEL A = A1, A3
   CHANNEL B = A2, A4
3. IF INSTRUMENT IS OPTION 001 OR 002, IS B AMPLITUDE ON THE SECOND PANEL METER READING + 0.6 dBV ± 1 dB?

3575-B-283IA

Figure 5-8. Amplitude Troubleshooting Tree.

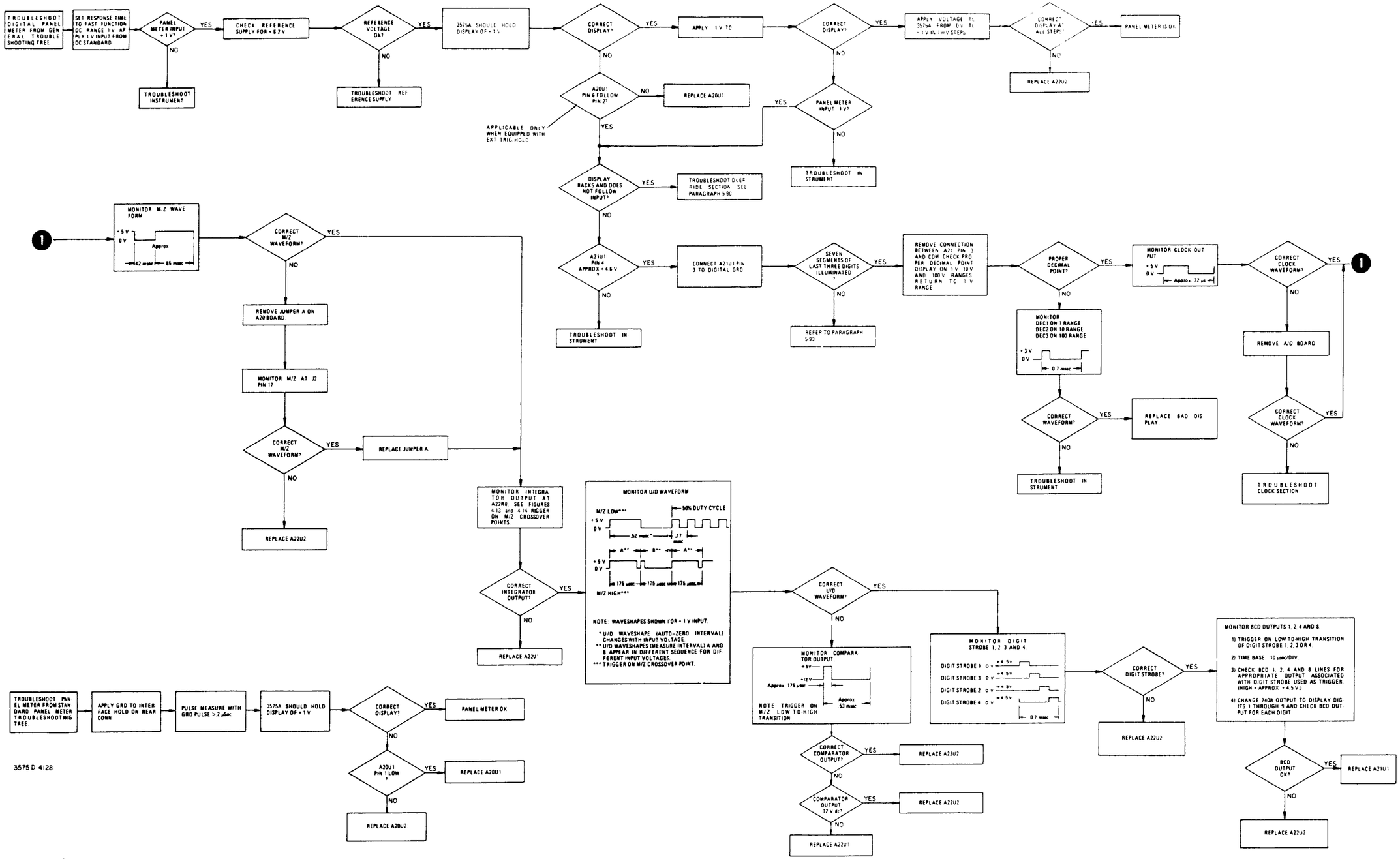
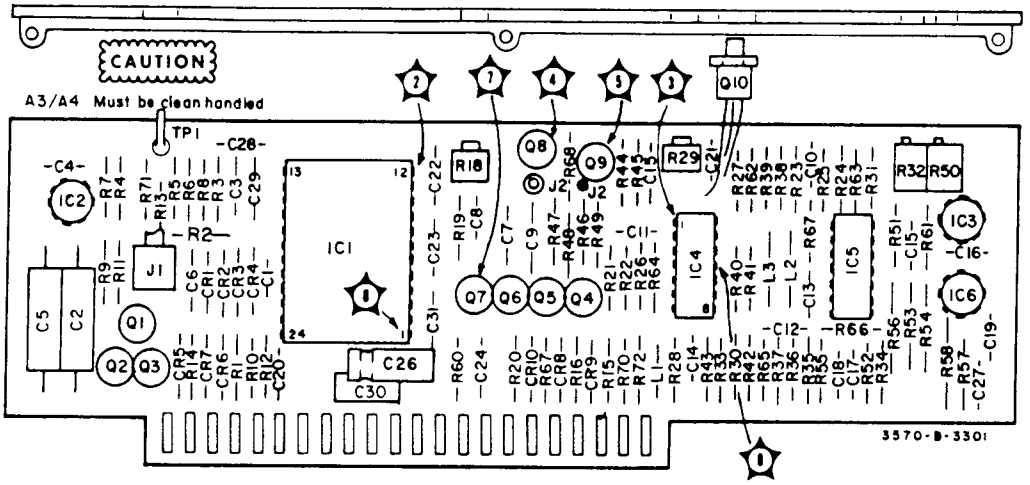


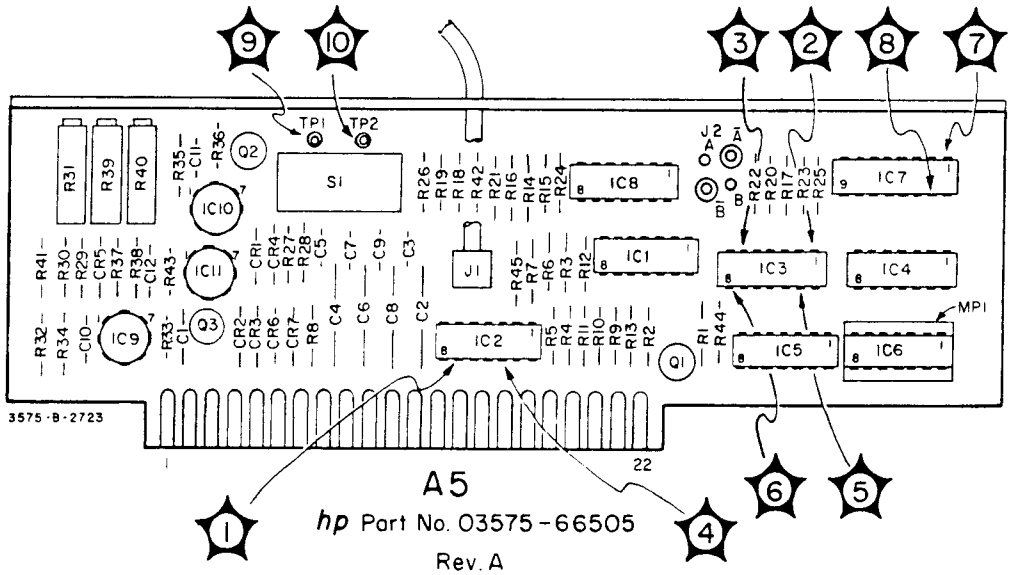

Figure 5-9. Digital Panel Meter Troubleshooting Tree.




A3 or A4

*hp* Part No. 03575-66503

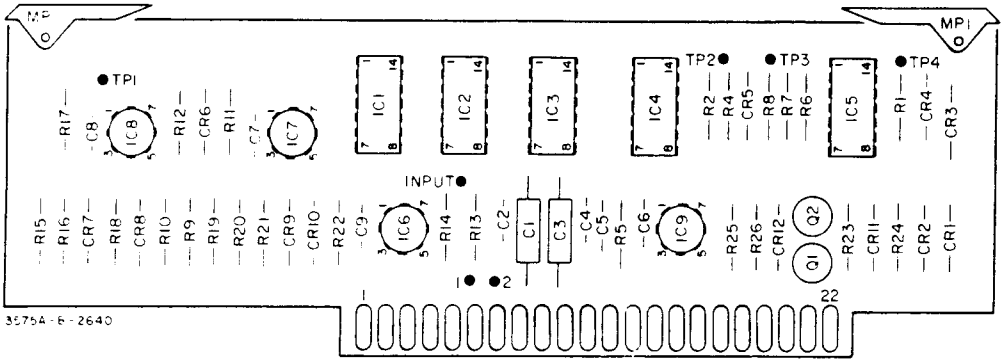
Rev. C




A5

*hp* Part No. 03575-66505

Rev. A




A11

*hp* Part No. 03575-66511

Rev A

**MEASUREMENT CONDITIONS:**

1) 2 V rms, 1 kHz APPLIED TO BOTH INPUTS.
2) INPUT SIGNALS IN PHASE.
3) DISPLAY SWITCH OR AMPLITUDE B/PHASE SWITCH SET TO PHASE.
4) VOLTAGE RANGE: 0.2 mV - 2 V (BOTH CHANNELS).
5) FREQUENCY RANGE: 10 Hz - 100 kHz.
6) PHASE REFERENCE: + A

**SIGNAL SOURCES:**

FREQUENCY SYNTHESIZER (-hp- 3320B)
TEST OSCILLATOR (-hp- 651B)
VARIABLE PHASE GENERATOR (-hp- 203A)

**FIGURE 1**

**SCOPE SETTINGS FOR FIGURES 1 AND 2.**

Vertical - .5 V/CM
Horizontal - .2 ms/CM
Trigger - Ext.
+ Slope
Trigger on Input from Signal Source

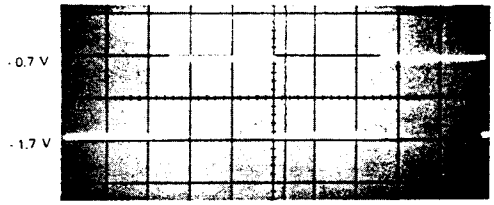
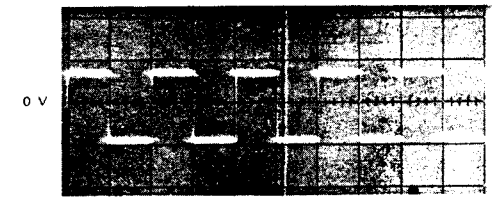



**FIGURE 2**



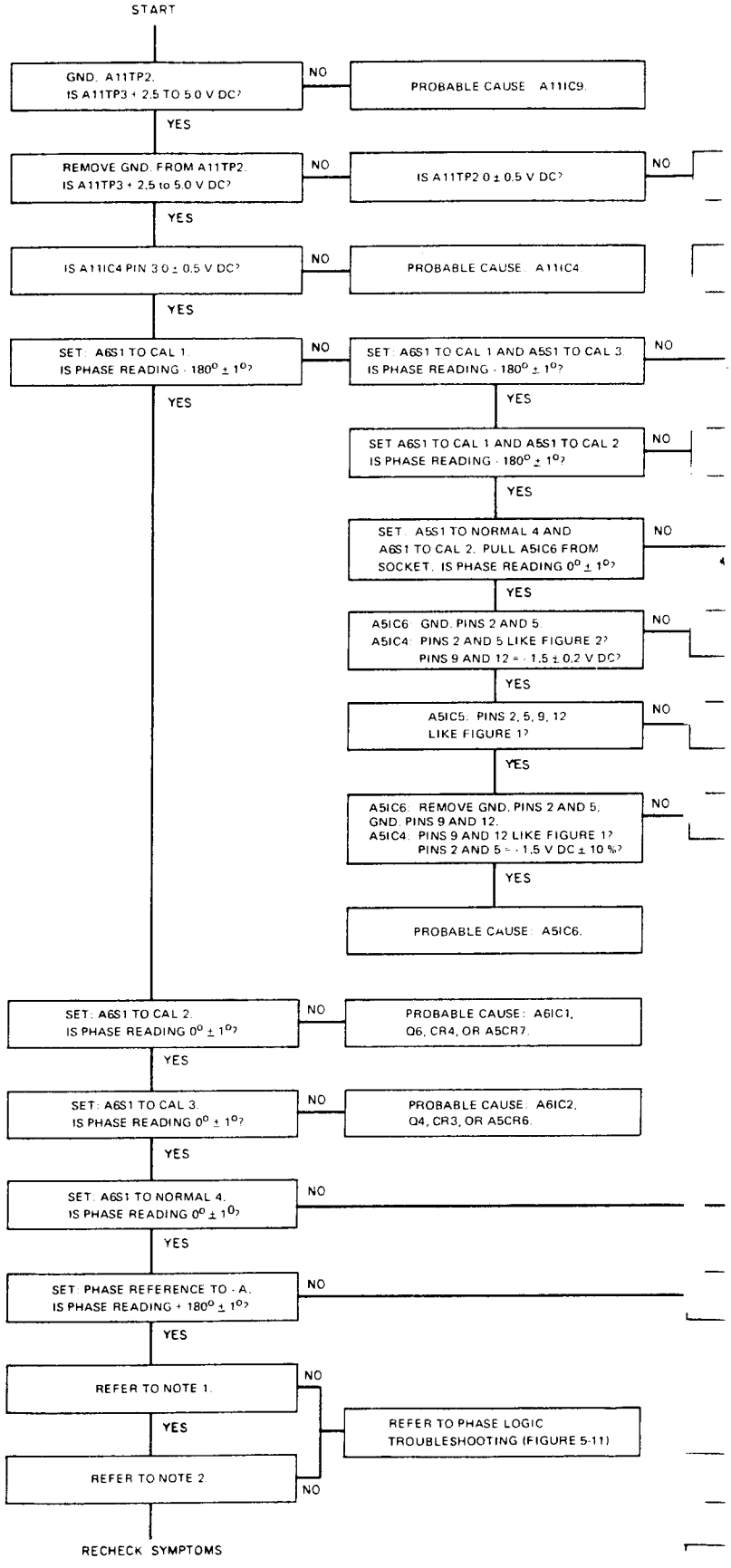

5 ms/cm .5 V/cm (10 x .05 V range)

**FIGURE 3**

**NOTES**

**NOTE 1:** TWO METHODS CAN BE USED TO PERFORM THE FOLLOWING TEST.
METHOD 1: SET THE -hp- 203A VARIABLE PHASE FUNCTION GENERATOR TO 0° PHASE SHIFT. ADJUST PHASE SHIFT IN A POSITIVE DIRECTION SOMEWHERE NEAR + 192.0°. THE PHASE READING WILL SHIFT TO - 168.0° ± 1°.
METHOD 2: DISCONNECT THE INPUT JUMPER ON A11. CONNECT A11TP2 TO A11TP4 AND SET A5S1 TO CAL 2. THE PHASE READING WILL BE + 180.0° ± 1°. CONNECT DC SUPPLY TO A11TP1 AND ADJUST DC LEVEL POSITIVE FROM 0 V TO + 2.00 V DC. SOMEWHERE NEAR + 2.0 V THE PHASE READING WILL CHANGE TO - 180.0° ± 1°.
DOES THE PHASE READING SHIFT AS DESCRIBED IN METHOD 1 OR METHOD 2?

**NOTE 2:** TWO METHODS CAN BE USED TO PERFORM THE FOLLOWING TEST.
METHOD 1: SET THE -hp- 203A TO 0° PHASE SHIFT AND ADJUST PHASE SHIFT IN A NEGATIVE DIRECTION. SOMEWHERE NEAR -192.0°. THE PHASE READING WILL SHIFT TO + 168.0° ± 1°.
METHOD 2: SET THE DC SUPPLY TO + 2.00 V. ADJUST THE DC SUPPLY IN A NEGATIVE DIRECTION. SOMEWHERE NEAR - 2.00 V THE PHASE READING SHOULD CHANGE FROM - 180.0° TO + 180.0° ± 1°.
DOES THE PHASE READING SHIFT AS DESCRIBED IN METHOD 1 OR METHOD 2?


START
GND. A11TP2. IS A11TP3 + 2.5 TO 5.0 V DC?
NO
PROBABLE CAUSE: A11IC9.
YES
REMOVE GND. FROM A11TP2. IS A11TP3 + 2.5 to 5.0 V DC?
NO
IS A11TP2 0 ± 0.5 V DC?
NO
YES
IS A11IC4 PIN 3 0 ± 0.5 V DC?
NO
PROBABLE CAUSE: A11IC4.
YES
SET: A6S1 TO CAL 1. IS PHASE READING - 180° ± 1°?
NO
SET: A6S1 TO CAL 1 AND A5S1 TO CAL 3. IS PHASE READING - 180° ± 1°?
NO
YES
YES
SET A6S1 TO CAL 1 AND A5S1 TO CAL 2 IS PHASE READING - 180° ± 1°?
NO
YES
SET: A5S1 TO NORMAL 4 AND A6S1 TO CAL 2. PULL A5IC6 FROM SOCKET. IS PHASE READING 0° ± 1°?
NO
YES
A5IC6: GND. PINS 2 AND 5
A5IC4: PINS 2 AND 5 LIKE FIGURE 2?
PINS 9 AND 12 = - 1.5 ± 0.2 V DC?
NO
YES
A5IC5: PINS 2, 5, 9, 12 LIKE FIGURE 1?
NO
YES
A5IC6: REMOVE GND. PINS 2 AND 5; GND. PINS 9 AND 12.
A5IC4: PINS 9 AND 12 LIKE FIGURE 1?
PINS 2 AND 5 = - 1.5 V DC ± 10 %?
NO
YES
PROBABLE CAUSE: A5IC6.
SET: A6S1 TO CAL 2. IS PHASE READING 0° ± 1°?
NO
PROBABLE CAUSE: A6IC1, Q6, CR4, OR A5CR7.
YES
SET: A6S1 TO CAL 3. IS PHASE READING 0° ± 1°?
NO
PROBABLE CAUSE: A6IC2, Q4, CR3, OR A5CR6.
YES
SET: A6S1 TO NORMAL 4. IS PHASE READING 0° ± 1°?
NO
YES
SET: PHASE REFERENCE TO - A. IS PHASE READING + 180° ± 1°?
NO
YES
REFER TO NOTE 1.
NO
YES
REFER TO PHASE LOGIC TROUBLESHOOTING (FIGURE 5-11)
REFER TO NOTE 2.
NO
RECHECK SYMPTOMS

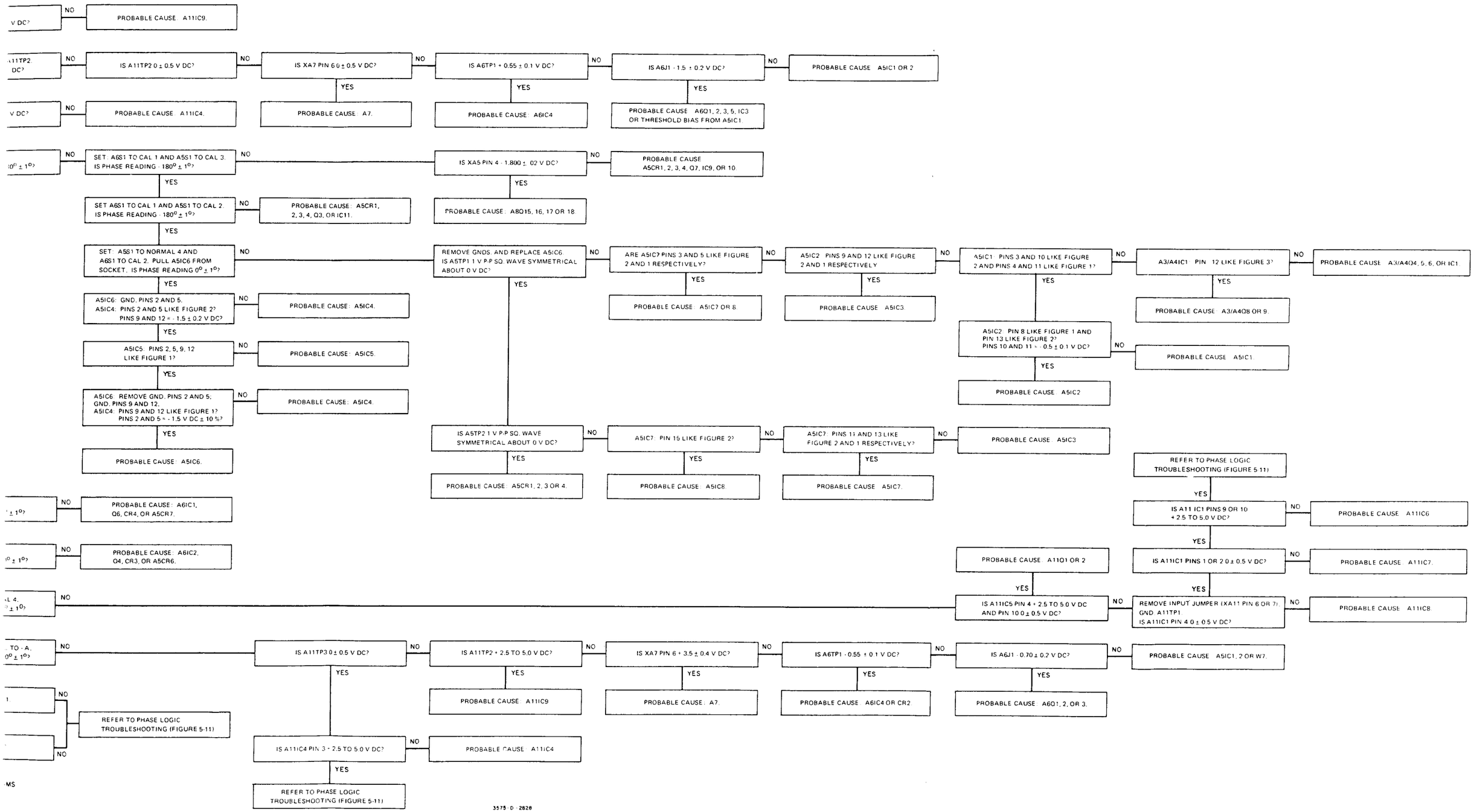
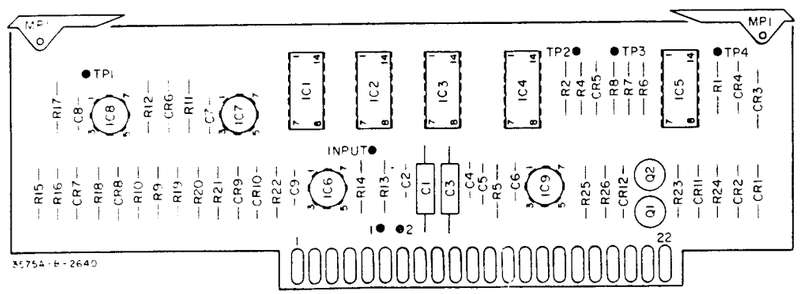

V DC?
NO
PROBABLE CAUSE: A11IC9.
A11TP2.
DC?
IS A11TP2 0 ± 0.5 V DC?
IS XA7 PIN 6 0 ± 0.5 V DC?
IS A6TP1 + 0.55 ± 0.1 V DC?
IS A6J1 - 1.5 ± 0.2 V DC?
PROBABLE CAUSE: A5IC1 OR 2.
YES
V DC?
PROBABLE CAUSE: A11IC4.
PROBABLE CAUSE: A7.
PROBABLE CAUSE: A6IC4
PROBABLE CAUSE: A6Q1, 2, 3, 5, IC3 OR THRESHOLD BIAS FROM A5IC1.
SET: A6S1 TO CAL 1 AND A5S1 TO CAL 3. IS PHASE READING - 180° ± 1°?
IS XA5 PIN 4 - 1.800 ± .02 V DC?
PROBABLE CAUSE A5CR1, 2, 3, 4, Q7, IC9, OR 10.
SET A6S1 TO CAL 1 AND A5S1 TO CAL 2. IS PHASE READING - 180° ± 1°?
PROBABLE CAUSE: A5CR1, 2, 3, 4, Q3, OR IC11.
PROBABLE CAUSE: A8O15, 16, 17 OR 18.
SET: A5S1 TO NORMAL 4 AND A6S1 TO CAL 2. PULL A5IC6 FROM SOCKET. IS PHASE READING 0° ± 1°?
REMOVE GNDS. AND REPLACE A5IC6. IS A5TP1 1 V P-P SQ. WAVE SYMMETRICAL ABOUT 0 V DC?
ARE A5IC7 PINS 3 AND 5 LIKE FIGURE 2 AND 1 RESPECTIVELY?
A5IC2 PINS 9 AND 12 LIKE FIGURE 2 AND 1 RESPECTIVELY
A5IC1 PINS 3 AND 10 LIKE FIGURE 2 AND PINS 4 AND 11 LIKE FIGURE 1?
A3/A4IC1 PIN 12 LIKE FIGURE 3?
PROBABLE CAUSE: A3/A4O4, 5, 6, OR IC1.
A5IC6: GND, PINS 2 AND 5. A5IC4: PINS 2 AND 5 LIKE FIGURE 2? PINS 9 AND 12 ≈ - 1.5 ± 0.2 V DC?
PROBABLE CAUSE: A5IC4.
PROBABLE CAUSE: A5IC7 OR 8.
PROBABLE CAUSE: A5IC3.
PROBABLE CAUSE: A3/A4O8 OR 9.
A5IC5: PINS 2, 5, 9, 12 LIKE FIGURE 1?
PROBABLE CAUSE: A5IC5.
A5IC2: PIN 8 LIKE FIGURE 1 AND PIN 13 LIKE FIGURE 2? PINS 10 AND 11 ≈ - 0.5 ± 0.1 V DC?
PROBABLE CAUSE: A5IC1.
A5IC6: REMOVE GND, PINS 2 AND 5; GND, PINS 9 AND 12. A5IC4: PINS 9 AND 12 LIKE FIGURE 1? PINS 2 AND 5 ≈ - 1.5 V DC ± 10 %?
PROBABLE CAUSE: A5IC4.
PROBABLE CAUSE: A5IC2
PROBABLE CAUSE: A5IC6.
IS A5TP2 1 V P-P SQ. WAVE SYMMETRICAL ABOUT 0 V DC?
A5IC7: PIN 15 LIKE FIGURE 2?
A5IC7: PINS 11 AND 13 LIKE FIGURE 2 AND 1 RESPECTIVELY?
PROBABLE CAUSE: A5IC3
PROBABLE CAUSE: A5CR1, 2, 3 OR 4.
PROBABLE CAUSE: A5IC8.
PROBABLE CAUSE: A5IC7.
REFER TO PHASE LOGIC TROUBLESHOOTING (FIGURE 5-11)
IS A11 IC1 PINS 9 OR 10 + 2.5 TO 5.0 V DC?
PROBABLE CAUSE: A11IC6
PROBABLE CAUSE: A6IC1, Q6, CR4, OR A5CR7.
PROBABLE CAUSE: A11Q1 OR 2
IS A11IC1 PINS 1 OR 2 0 ± 0.5 V DC?
PROBABLE CAUSE: A11IC7.
PROBABLE CAUSE: A6IC2, Q4, CR3, OR A5CR6.
IS A11IC5 PIN 4 + 2.5 TO 5.0 V DC AND PIN 10 0 ± 0.5 V DC?
REMOVE INPUT JUMPER (XA11 PIN 6 OR 7). GND A11TP1. IS A11IC1 PIN 4 0 ± 0.5 V DC?
PROBABLE CAUSE: A11IC8
IS A11TP3 0 ± 0.5 V DC?
IS A11TP2 + 2.5 TO 5.0 V DC?
IS XA7 PIN 6 + 3.5 ± 0.4 V DC?
IS A6TP1 - 0.55 ± 0.1 V DC?
IS A6J1 - 0.70 ± 0.2 V DC?
PROBABLE CAUSE: A5IC1, 2 OR W7.
REFER TO PHASE LOGIC TROUBLESHOOTING (FIGURE 5-11)
PROBABLE CAUSE: A11IC9
PROBABLE CAUSE: A7.
PROBABLE CAUSE: A6IC4 OR CR2
PROBABLE CAUSE: A6Q1, 2, OR 3.
IS A11IC4 PIN 3 - 2.5 TO 5.0 V DC?
PROBABLE CAUSE: A11IC4
REFER TO PHASE LOGIC TROUBLESHOOTING (FIGURE 5-11)
3575-D-2828

Figure 5-10. Phase Troubleshooting Tree.

LOGIC LEVELS FOR A11IC1, IC2, IC3 AND IC5.

| IC NO. | PIN NO. | INPUT LEVELS (A11TP1) | |
|---|---|---|---|
| | | + 2.00 V | - 2.00 V |
| 1 | 6 | 1 | 0 |
| 1 | 11 | 0 | 1 |
| 2 | 6 | 1 | 0 |
| 2 | 8 | 0 | 1 |
| 2 | 12 | 0 | 1 |
| 3 | 6 | 1 | 0 |
| 3 | 11 | 1 | 0 |
| 5 | 1 | 0 | 0 |
| 5 | 4 | 1 | 0 |
| 5 | 10 | 1 | 0 |
| 5 | 13 | 0 | 0 |




A11

*hp* Part No. 03575-66511

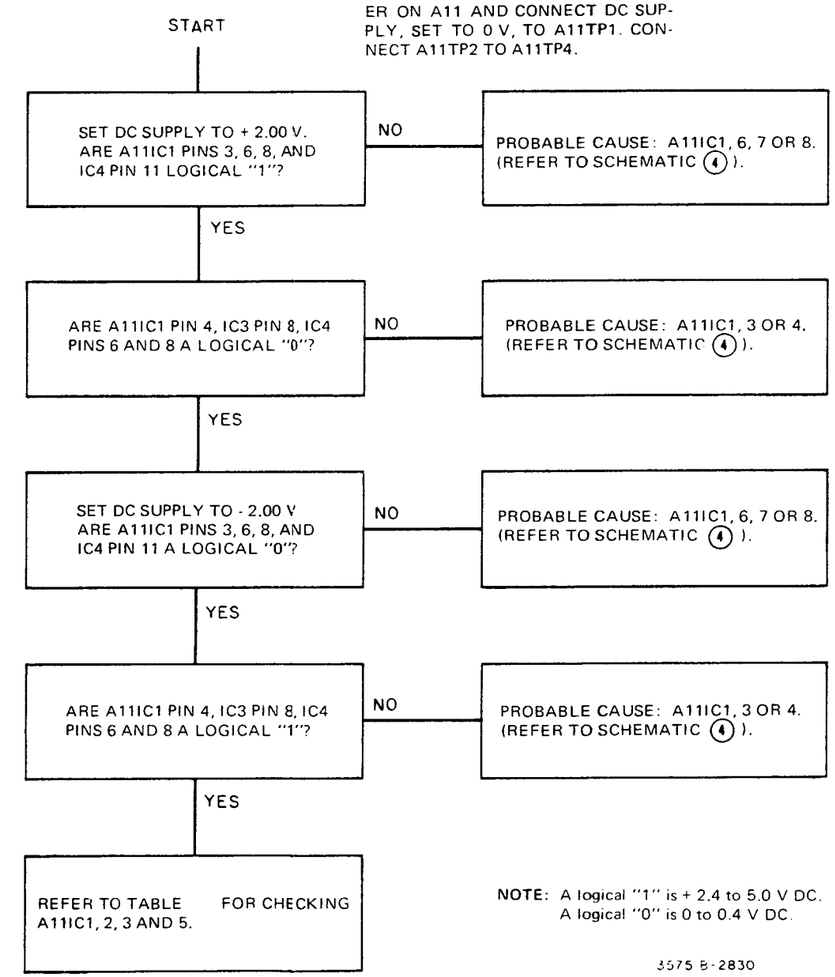
Rev A

**MEASUREMENT CONDITIONS:**

1) NO SIGNAL INPUTS APPLIED.

2) PHASE REFERENCE: + A

3) DISCONNECT THE INPUT JUMPER ON A11 AND CONNECT DC SUPPLY, SET TO 0 V, TO A11TP1. CONNECT A11TP2 TO A11TP4.


START
SET DC SUPPLY TO + 2.00 V. ARE A11IC1 PINS 3, 6, 8, AND IC4 PIN 11 LOGICAL "1"?
NO
PROBABLE CAUSE: A11IC1, 6, 7 OR 8. (REFER TO SCHEMATIC 4).
YES
ARE A11IC1 PIN 4, IC3 PIN 8, IC4 PINS 6 AND 8 A LOGICAL "0"?
NO
PROBABLE CAUSE: A11IC1, 3 OR 4. (REFER TO SCHEMATIC 4).
YES
SET DC SUPPLY TO - 2.00 V ARE A11IC1 PINS 3, 6, 8, AND IC4 PIN 11 A LOGICAL "0"?
NO
PROBABLE CAUSE: A11IC1, 6, 7 OR 8. (REFER TO SCHEMATIC 4).
YES
ARE A11IC1 PIN 4, IC3 PIN 8, IC4 PINS 6 AND 8 A LOGICAL "1"?
NO
PROBABLE CAUSE: A11IC1, 3 OR 4. (REFER TO SCHEMATIC 4).
YES
REFER TO TABLE A11IC1, 2, 3 AND 5. FOR CHECKING

**NOTE:** A logical "1" is + 2.4 to 5.0 V DC.
A logical "0" is 0 to 0.4 V DC.

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Figure 5-11. Phase Logic Troubleshooting Tree.

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (Qty column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

d. Manufacturers part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

## 6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

## 6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.
b. Instrument serial number.
c. Description of the part.
d. Function and location of the part.

## 6-8. PROPRIETARY PARTS.

6-9. Items marked by a dagger (†) in the reference designator column are available only for repair and service of Hewlett-Packard instruments.

### ABBREVIATIONS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ag | silver | Hz | hertz (cycle(s) per second) | NPO | negative positive zero (zero temperature coefficient) | sl | slide |
| Al | aluminum | | | | | SPDT | single pole double throw |
| A | ampere(s) | ID | inside diameter | ns | nanosecond(s) $10^{-9}$ seconds | SPST | single pole single throw |
| Au | gold | impg | impregnated | nsr | not separately replaceable | | |
| | | incd | incandescent | | | Ta | tantalum |
| C | capacitor | ins | insulation(ed) | Ω | ohm(s) | TC | temperature coefficient |
| cer | ceramic | | | obd | order by description | $TiO_2$ | titanium dioxide |
| coef | coefficient | kΩ | kilohm(s) = $10^{+3}$ ohms | OD | outside diameter | tog | toggle |
| com | common | kHz | kilohertz = $10^{+3}$ hertz | | | tol | tolerance |
| comp | composition | | | p | peak | trim | trimmer |
| conn | connection | L | inductor | pA | picoampere(s) | TSTR | transistor |
| | | lin | linear taper | pc | printed circuit | | |
| dep | deposited | log | logarithmic taper | pF | picofarad(s) $10^{-12}$ farads | V | volt(s) |
| DPDT | double pole double throw | | | piv | peak inverse voltage | vacw | alternating current working voltage |
| DPST | double pole single throw | mA | milliampere(s) = $10^{-3}$ amperes | p/o | part of | var | variable |
| | | MHz | megahertz = $10^{+6}$ hertz | pos | position(s) | vdcw | direct current working voltage |
| elect | electrolytic | MΩ | megohm(s) = $10^{+6}$ ohms | poly | polystyrene | | |
| encap | encapsulated | met flm | metal film | pot | potentiometer | W | watt(s) |
| | | mfr | manufacturer | p-p | peak-to-peak | w/ | with |
| F | farad(s) | ms | millisecond | ppm | parts per million | wiv | working inverse voltage |
| FET | field effect transistor | mtg | mounting | prec | precision (temperature coeffient, long term stability and or tolerance) | w/o | without |
| fxd | fixed | mV | millivolt(s) = $10^{-3}$ volts | | | ww | wirewound |
| | | μF | microfarad(s) | | | | |
| GaAs | gallium arsenide | μs | microsecond(s) | R | resistor | | |
| GHz | gigahertz $10^{+9}$ hertz | μV | microvolt(s) = $10^{-6}$ volts | Rh | rhodium | * | optimum value selected at factory, average value shown (part may be omitted) |
| gd | guard(ed) | my | Mylar® | rms | root-mean-square | ** | no standard type number assigned selected or special type |
| Ge | germanium | | | rot | rotary | | |
| gnd | ground(ed) | nA | nanoampere(s) $10^{-9}$ amperes | | | | |
| | | NC | normally closed | Se | selenium | | |
| H | henry(ies) | Ne | neon | sect | section(s) | | |
| Hg | mercury | NO | normally open | Si | silicon | | ® Dupont de Nemours |

### DECIMAL MULTIPLIERS

| Prefix | Symbols | Multiplier | Prefix | Symbols | Multiplier |
|---|---|---|---|---|---|
| tera | T | $10^{12}$ | centi | c | $10^{-2}$ |
| giga | G | $10^{9}$ | milli | m | $10^{-3}$ |
| mega | M or Meg | $10^{6}$ | micro | μ | $10^{-6}$ |
| kilo | K or k | $10^{3}$ | nano | n | $10^{-9}$ |
| hecto | h | $10^{2}$ | pico | p | $10^{-12}$ |
| deka | da | 10 | femto | f | $10^{-15}$ |
| deci | d | $10^{-1}$ | atto | a | $10^{-18}$ |

STD-B-2734

### DESIGNATORS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | assembly | FL | filter | Q | transistor | TS | terminal strip |
| B | motor | HR | heater | QCR | transistor-diode | U | microcircuit |
| BT | battery | IC | integrated circuit | R | resistor | V | vacuum tube, neon bulb, photocell, etc |
| C | capacitor | J | jack | RT | thermistor | W | cable |
| CR | diode | K | relay | S | switch | X | socket |
| DL | delay line | L | inductor | T | transformer | XDS | lampholder |
| DS | lamp | M | meter | TB | terminal board | XF | fuseholder |
| E | misc electronic part | MP | mechanical part | TC | thermocouple | Y | crystal |
| F | fuse | P | plug | TP | test point | Z | network |

## Table 6-1. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A1 | 03575-66501 | 2 | BOARD ASSY:PRE-AMPLIFIER | 28480 | 03575-66501 |
| A1C1 | 0160-3402 | 4 | C:FXD POLY 1.0 UF 5% 50VDCW | 84411 | HEW 138 |
| A1C2 | C121-0059 | 3 | C:VAR CER 2-8 PF | 28480 | 0121-0059 |
| A1C3 | 0160-2203 | 2 | C:FXD MICA 91 PF 5% | 72136 | RDM15F910J3C |
| A1C4 | 0160-3402 | | C:FXD POLY 1.0 UF 5% 50VDCW | 84411 | HEW 138 |
| A1C5 | 0160-3622 | 45 | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C6 | 0160-2204 | 9 | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A1C7 | 0170-0055 | 2 | C:FXD MY 0.1UF 20% 200VDCW | 56289 | 192P10402 |
| A1C8 | 0160-2055 | 11 | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| ‡ A1C9 | 0140-0232 | | C: FXD MICA 460 pF 1% | 72136 | OBD |
| A1C10 | 0160-0362 | 2 | C:FXD MICA 510PF 5% | 28480 | 0160-0362 |
| A1C11 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A1C12 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A1C13 | | | NOT ASSIGNED | | |
| A1C14 | 0180-0309 | 3 | C:FXD ELECT 4.7 UF 20% 10VDCW | 56289 | 150D475X0010A2-DYS |
| A1C15 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C16 | C180-1835 | 8 | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A1C17 | 0180-0106 | 9 | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A1C18 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C19 | 0160-0128 | 12 | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A1C20 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A1C21 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C22 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C23 | 0180-1835 | | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A1C24 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A1C25 | | | NOT ASSIGNED | | |
| A1C26 | 0160-0128 | | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A1C27 | 0160-2130 | 2 | C: FXD MICA 865 pF 1% 100 VDCW | 00853 | OBD |
| A1C28 | 0160-0763 | | C: FXD MICA 5 PF 10% 500 VDCW | 28480 | 0160-0763 |
| A1CR1, A1CR2 | 1901-0040 | 82 | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A1CR3 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A1CR4 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A1CR5 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A1CR6 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A1IC1 | 1820-0478 | 4 | IC:LINEAR OPERATIONAL AMPLIFIER | 12040 | LM 308H |
| A1J1 | 0362 - 0350 | 2 | TERMINATION: CRIMP LUG | 59730 | GSF - 156 |
| A1J2 | 1251-1195 | 3 | CONNECTOR: RF | 28480 | 1251-1195 |
| A1K1 | 0490-0366 | 4 | SWITCH:REED RELAY SPNO CONTACT | 28480 | 0490-0366 |
| A1K1 | 0490-1046 | 4 | RELAY:REED COIL ASSY | 28480 | 0490-1046 |
| A1K2 | 0490-0366 | | SWITCH:REED RELAY SPNO CONTACT | 28480 | 0490-0366 |
| A1K2 | 0490-1046 | | RELAY:REED COIL ASSY | 28480 | 0490-1046 |
| ‡ A1L1 | 9100-1644 | 2 | COIL: MOLDED CHOKE 330 UH 5% | 82142 | 19-1331-23J |
| A1L2 thru A1L5 | 9170-0894 | | BEAD: SHIELDING CORE, MAGNETIC | 28480 | 9170-0894 |
| A1MP1 | 1400-0760 | 8 | CLIP: MOUNTING ASSY (SET OF 3) | 28480 | 1400-0760 |
| A1Q1 | 1854-0071 | 28 | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q3 | 1855-0081 | 5 | TSTR:SI FET | 80131 | 2N5245 |
| A1Q4 | 1853-0203 | 8 | TSTR:SI PNP | 28480 | 1853-0203 |
| A1Q5 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A1Q6 | 1854-0354 | 2 | TSTR:SI NPN | 28480 | 1854-0354 |
| A1Q7 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A1Q8 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q9 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q10 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1R1 | 0684-1031 | 23 | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A1R2 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A1R3 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A1R4 | 2100-2633 | 2 | R:VAR CERMET 1K OHM 10% LIN 1/2W | 28480 | 2100-2633 |
| A1R5 | 0757-0187 | 2 | R:FXD MET FLM 900K OHM 0.1% 1/2W | 28480 | 0757-0187 |
| A1R6 | 0698-4158 | 2 | R:FXD FLM 100K OHM 0.1% 1/8W | 28480 | 0698-4158 |
| A1R7 | 0684-1011 | 21 | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A1R8 | 0684-1061 | 15 | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A1R9 | 0684-1041 | 51 | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A1R10 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| ‡ A1R11 | 0757-0282 | | R: FXD MET FLM 221 OHM 1% 1/8 W | 28480 | 0757-0282 |
| A1R12 | 0684-1001 | 10 | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A1R13 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A1R14 | 0757-0280 | 8 | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A1R15 | 0757-0401 | | R:FXD COMP 100 OHM 10% 1/8W | 14674 | C4 - T-0 |
| A1R16 | 0757-0280 | | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A1R17 | 0698-4424 | 2 | R:FXD FLM 1400 OHM 1% 1/8W | 28480 | 0698-4424 |
| A1R18 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A1R19 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A1R20 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| ‡ A1R21 | 0698-4469 | | R: FXD FLM 1.15 K OHM 1% 1/8 W | 28480 | 0698-4469 |

‡ See Appendix C, Manual Backdating, Change 1, 2

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| ‡ A1R22 | 0698-4391 | 2 | R:FXD FLM 69.8 OHM 1% 1/8 W | 91637 | CMF-1/10-32 T-1 |
| ‡ A1R23 | 0698-3557 | | R:FXD FLM 806 OHM 1% 1/8 W | 91637 | MF-1/10-32 T-1 |
| A1R24 | 0757-0273 | 8 | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A1R25 | 0698-3515 | 2 | R:FXD FLM 5900 OHM 1% 1/8W | 28480 | 0698-3515 |
| A1R26 | 0698-4480 | 4 | R:FXD MET FLM 15.8K OHM 1% 1/8W | 28480 | 0698-4480 |
| A1R27 | 0698-4486 | 2 | R:FXD MET FLM 24.9K OHM 1% 1/8W | 28480 | 0698-4486 |
| A1R28 | 0698-4499 | 2 | R:FXD FLM 54.9K OHM 1% 1/8W | 28480 | 0698-4499 |
| A1R29 | 0757-0283 | 4 | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A1R30 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A1R31 | 0698-5101 | 8 | R:FXD COMP 33 OHM 10% 1/4W | 01121 | CB 3301 |
| A1R32 | 0698-5101 | | R:FXD COMP 33 OHM 10% 1/4W | 01121 | CB 3301 |
| A1R33 | 0698-5101 | | R:FXD COMP 33 OHM 10% 1/4W | 01121 | CB 3301 |
| A1R34 | 0698-5101 | | R:FXD COMP 33 OHM 10% 1/4W | 01121 | CB 3301 |
| A1R35 | 0698-4480 | | R:FXD MET FLM 15.8K OHM 1% 1/8W | 28480 | 0698-4480 |
| A1R36 | 0698-3519 | 2 | R:FXD MET FLM 12.4K OHM 1% 1/8W | 28480 | 0698-3519 |
| A1R37 | 0698-3548 | 5 | R:FXD MET FLM 732 OHM 1% 1/8W | 28480 | 0698-3548 |
| A1R38 | 0757-0465 | 14 | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| ‡ A1R39 | 0698-3122 | | R:FXD FLM 412 OHM 1% 1/8 W | 91637 | CMF-1/10-32 T-1 |
| A1R40 | 2100-2516 | | R:VARCER 100K OHM 10% LIN 1/2W | 28480 | 2100-2516 |
| A1R41 | 0698-4499 | | R:FXD FLM 54.9K 1% 1/8W | 28480 | 0698-4499 |
| A1R42 | 0698-4396 | | R:FXD FLM 80.6 OHM 1% 1/8W | 28480 | 0698-4396 |
| A1R43 | 0698-4374 | | R:FXD FLM 29.4 OHM 1% 1/8W | 28480 | 0698-4374 |
| A2 (SAME AS A1) | 03575-66501 | | BOARD ASSY: PRE - AMPLIFIER | 28480 | 03575-66501 |
| A3 | 03575-66503 | | BOARD ASSY, LOG CONVERTER | 28480 | 03575-66501 |
| ‡ A3C1 | 0160-3622 | | C:FXD CER 0.1 UF +80% -20% 100 VDCW | 72982 | 8131-100-651-104Z |
| A3C2 | 0160-3787 | 4 | C:FXD POLY 1.0 UF 10% 50VDCW | 28480 | 0160-3787 |
| A3C3 | 0160-2218 | 2 | C:FXD MICA 1000 PF 5% | 28480 | 0160-2218 |
| A3C4 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A3C5 | 0160-3787 | | C:FXD POLY 1.0 UF 10% 50VDCW | 28480 | 0160-3787 |
| A3C6 | 0160-0127 | 2 | C:FXD CER 1.0 UF 20% 25VDCW | 56289 | 5C13C5-CML |
| A3C7 | 0140-0180 | 2 | C:FXD MICA 2000 PF 2% | 28480 | 0140-0180 |
| A3C8 | 0160-2530 | 2 | C:FXD MICA 180 PF 2% 300VDCW | 00853 | RDM15F181G3S |
| A3C9 | 0160-3435 | 2 | C:FXD MY 0.047 UF 10% 50VDCW | 28480 | 0160-3435 |
| ‡ A3C10 | 0160-3622 | | C:FXD CER 0.1 UF +80% -20% 100 VDCW | 72982 | 8131-100-651-104Z |
| A3C11 | 0160-2322 | 2 | C:FXD MICA 18 PF 5% 100VDCW | 00853 | RDM15C180J1S |
| A3C12 | 0140-0202 | 4 | C:FXD MICA 15 PF 5% 500VDCW | 28480 | 0140-0202 |
| A3C13 | 0140-0202 | | C:FXD MICA 15 PF 5% 500VDCW | 28480 | 0140-0202 |
| A3C14 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C15 | 0180-1701 | 4 | C:FXD ELECT 6.8 UF 20% 6VDCW | 28480 | 0180-1701 |
| A3C16 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A3C17 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C18 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C19 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C20 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C21 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C22 | 0160-0128 | | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A3C23 | 0160-0128 | | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A3C24 | 0180-1701 | | C:FXD ELECT 6.8 UF 20% 6VDCW | 28480 | 0180-1701 |
| A3C25 | 0140-0200 | 8 | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A3C26 | 0180-2419 | 6 | C:FXD TANT. 470 UF 20% 10VDCW | 56289 | 109D477X0010F2 |
| A3C27 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C28 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A3C29 | 0160-0128 | | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A3C30 | 0180-0229 | 12 | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A3C31 | 0160-0128 | | C:FXD CER 2.2 UF 20% 25VDCW | 56289 | 5C152C2S-CML |
| A3CR1 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR2 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR3 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR4 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR5 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR6 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR7 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR8 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR9 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A3CR10 | 1901-0040 | | DIODE:SILICON 30WV | 07263 | FDG1088 |
| A3IC1† | 1813-0002 | 2 | IC:HYBRID | 28480 | 1813-0002 |
| A3IC2 | 1820-0478 | | IC:LINEAR OPERATIONAL AMPLIFIER | 12040 | LM 308H |
| A3IC3 | 1826-0059 | 8 | IC:LINEAR OPER. AMPL. | 12040 | LM201AD |
| A3IC4 | 03575-80001 | 2 | TRANSISTOR ARRAY:SI NPN | 28480 | 03575-80001 |
| A3IC5 | 1858-0019 | 3 | TSTR ARRAY:DUAL INDEP. DIFFERENTIAL | 02735 | CA 3054 |
| A3IC6 | 1826-0059 | | IC:LINEAR OPER. AMPL. | 12040 | LM201AD |
| A3J2 | 1251-1636 | 4 | CONNECTOR:SINGLE MALE CONTACT | 28480 | 1251-1636 |
| A3J2 | 0360-1715 | 4 | TERMINAL:SOLDER STUD 0.040" SHANK DIA | 00000 | OBD |
| A3L1 * | 9100-3294 | 2 | INDUCTOR: FXD 0.35-0.55 UH | 28480 | 9100-3294 |
| A3L2 | 9140-0018 | 4 | COIL: FXD 1 UH | 99848 | 205-11-10 |
| A3L3 | 9140-0018 | | COIL: FXD 1 UH | 99848 | 205-11-10 |
| A3L4 | 9170-0894 | | BEAD: SHIELDING CORE, MAGNETIC | 28480 | 9170-0894 |
| A3MP1 | 1205-0220 | 2 | HEAT SINK:FOR TO-5 TRANSISTOR | 05820 | 260-10SH5E |
| A3Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A3Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |

‡See Appendix C, Manual Backdating, Change 1, 2

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A3Q3 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A3Q4 | 1853-0020 | 23 | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A3Q5 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A3Q6 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A3Q7 | 1853-0203 | | TSTR:SI PNP | 28480 | 1853-0203 |
| A3Q8 | 1853-0089 | 4 | TSTR:SI PNP | 80131 | 2N4917 |
| A3Q9 | 1853-0089 | | TSTR:SI PNP | 80131 | 2N4917 |
| A3Q10 | 5080-9064 | 2 | TSTR:SI NPN ASSY | 28480 | 5080-9064 |
| A3R1 | 0698-3558 | 2 | R:FXD MET FLM 4.02K OHM 1% 1/8W | 28480 | 0698-3558 |
| A3R2 | 0698-3447 | 2 | R:FXD MET FLM 422 OHM 1% 1/8W | 28480 | 0698-3447 |
| A3R3 | 0698-4445 | 2 | R:FXD FLM 5.76K OHM 1% 1/8W | 28480 | 0698-4445 |
| A3R4 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A3R5 | 0757-0442 | 2 | R:FXD MET FLM 10.0K OHM 1% 1/8W | 28480 | 0757-0442 |
| A3R6 | 0757-0283 | | R:FXD MET FLM 2.00K OHM 1% 1/8W | 28480 | 0757-0283 |
| A3R7 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A3R8 | 0757-0346 | 4 | R:FXD MET FLM 10 OHM 1% 1/8W | 28480 | 0757-0346 |
| A3R9 | 0757-0410 | | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A3R10 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3R11 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A3R12 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| ‡ A3R13 | 0698-3262 | | R: FXD FLM 40.2 OHM 1% 1/8 W | 91637 | CMF-1/10-32 T-1 |
| A3R14 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3R15 | 0684-2721 | 19 | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A3R16 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A3R17 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A3R18 | 2100-2583 | 2 | R:VAR CERMET 10 OHM 2% LIN 1/2W | 28480 | 2100-2583 |
| A3R19 | 0757-0402 | 2 | R:FXD MET FLM 110 OHM 1% 1/8W | 28480 | 0757-0402 |
| A3R20 | 0684-1021 | 8 | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A3R21 | 0757-0161 | 2 | R:FXD FLM 604 OHM 1% 1/8W | 28480 | 0757-0161 |
| A3R22 | 0757-0284 | 4 | R:FXD MET FLM 150 OHM 1% 1/8W | 28480 | 0757-0284 |
| ‡ A3R23 | 0698-3437 | | R: FXD FLM 133 OHM 1% 1/8 W | 91637 | CMF-1/10-32 T-1 |
| A3R24 | 0698-4391 | 4 | R:FXD FLM 69.8 OHM 1% 1/8W | 28480 | 0698-4391 |
| A3R25 | 0698-4391 | | R:FXD FLM 69.8 OHM 1% 1/8W | 28480 | 0698-4391 |
| A3R26 | 0698-3700 | 4 | R:FXD FLM 715 OHM 1% 1/8W | 28480 | 0698-3700 |
| A3R27 | 0698-4125 | 2 | R:FXD FLM 953 OHM 1% 1/8W | 28480 | 0698-4125 |
| A3R28 | 0757-0407 | 10 | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A3R29 | 2100-2632 | 2 | R:VAR FLM 100 OHM 10% LIN 1/2W | 28480 | 2100-2632 |
| A3R30 | 0698-4459 | 2 | R:FXD FLM 634 OHM 1% 1/8W | 28480 | 0698-4459 |
| A3R31* | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A3R32 | 2100-3338 | 2 | R:VAR FLM 5000 OHM 10% LIN 1/2W | 28480 | 2100-3338 |
| A3R33 | 0698-3700 | | R:FXD FLM 715 OHM 1% 1/8W | 28480 | 0698-3700 |
| A3R34 | 0698-6326 | 4 | R:FXD FLM 500 OHM 1% 1/8W | 28480 | 0698-6326 |
| A3R35 | 0698-6326 | | R:FXD FLM 500 OHM 1% 1/8W | 28480 | 0698-6326 |
| A3R36 | 0698-3440 | 2 | R:FXD FLM 196 OHM 1% 1/8W | 28480 | 0698-3440 |
| A3R37 | 0757-0413 | 2 | R:FXD MET FLM 392 OHM 1% 1/8W | 28480 | 0757-0413 |
| A3R38 | 0698-5546 | 4 | R:FXD FLM 174 OHM 1% 1/8W | 28480 | 0698-5546 |
| A3R39 | 0698-5546 | | R:FXD FLM 174 OHM 1% 1/8W | 28480 | 0698-5546 |
| A3R40 | 0698-5545 | 4 | R:FXD FLM 78.7 OHM 1% 1/8W | 28480 | 0698-5545 |
| A3R41 | 0698-5545 | | R:FXD FLM 78.7 OHM 1% 1/8W | 28480 | 0698-5545 |
| ‡ A3R42 | 0757-0405 | 2 | R: FXD FLM 162 OHM 1% 1/8 W | 28480 | 0757-0405 |
| A3R43 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A3R44 | 0684-1001 | | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A3R45 | 0698-3441 | 3 | R:FXD MET FLM 215 OHM 1% 1/8W | 28480 | 0698-3441 |
| A3R46 | 0757-0407 | | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A3R47 | 0757-0407 | | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A3R48 | 0757-0407 | | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A3R49 | 0757-0407 | | R:FXD MET FLM 200 OHM 1% 1/8W | 28480 | 0757-0407 |
| A3R50 | 2100-3339 | 2 | R:VAR CERMET 100K OHM 10% 1/2W, Type X | 28480 | 2100-3339 |
| A3R51 | 0698-3551 | 4 | R:FXD FLM 280K OHM 1% 1/8W | 28480 | 0698-3551 |
| A3R52 | 0698-6797 | 4 | R:FXD FLM 660 OHM 1% 1/8W | 28480 | 0698-6797 |
| A3R53 | 0698-8161 | 8 | R:FXD MET FLM 20K OHM 1.0% 0.1W | 28480 | 0698-8161 |
| A3R54 | 0698-8161 | | R:FXD MET FLM 20K OHM 1.0% 0.1W | 28480 | 0698-8161 |
| A3R55 | 0698-6797 | | R:FXD FLM 660 OHM 1% 1/8W | 28480 | 0698-6797 |
| A3R56 | 0698-8161 | | R:FXD MET FLM 20K OHM 1.0% 0.1W | 28480 | 0698-8161 |
| A3R57 | 0698-3551 | | R:FXD FLM 280K OHM 1% 1/8W | 28480 | 0698-3551 |
| A3R58 | 0698-8161 | | R:FXD MET FLM 20K OHM 1.0% 0.1W | 28480 | 0698-8161 |
| A3R59 | | | NOT ASSIGNED | | |
| A3R60 | 0684-0271 | 2 | R:FXD COMP 2.7 OHM 10% 1/4W | 01121 | CB 27G1 |
| A3R61 | 0757-0446 | 2 | R:FXD MET FLM 15.0K OHM 1% 1/8W | 28480 | 0757-0446 |
| A3R62 | 0698-6630 | 2 | R:FXD MET FLM 20K OHM 0.1% 1/8W | 28480 | 0698-6630 |
| A3R63 | 0698-6629 | 2 | R:FXD FLM 60K OHM 0.1% 1/8W | 28480 | 0698-6629 |
| A3R64 | 0684-2201 | 2 | R:FXD COMP 22 OHM 10% 1/4W | 01121 | CB 2201 |
| A3R65 | 0684-1511 | 2 | R:FXD COMP 150 OHM 10% 1/4W | 01121 | CB 1511 |
| A3R66 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3R67 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |

‡ See Appendix C, Manual Backdating, Change 1, 2

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A3R68 | 0684-1011 | | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A3R69, R70 | 0684-3921 | 6 | R:FXD COMP 3900 OHM 10% 1/4W | 01121 | CB 3921 |
| A3R71 | 0698-4445 | | R: FXD FLM 5.76K OHM 1% 1/8 W | 16299 | C4-1/8-TO-5761-F |
| A4 (SAME AS A3) | 03575-66503 | | BOARD ASSY: LOG CONVERTER | 28480 | 03575-66503 |
| A5 | 03575-66505 | 1 | BOARD ASSY:PHASE DETECTOR | 28480 | 03575-66505 |
| A5C1 | 0150-0084 | 2 | C:FXD CER 0.1 UF +80% -20% 100 VDCW | 72982 | 8131-100-651-104Z |
| A5C2 | 0180-1746 | 4 | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A5C3 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A5C4 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A5C5 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A5C6 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A5C7 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A5C8 | 0180-1746 | | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A5C9 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A5C10 * | | | NOT ASSIGNED | | |
| A5C11 * | | | NOT ASSIGNED | | |
| A5C12 * | | | NOT ASSIGNED | | |
| A5CR1 | 1901-0518 | 6 | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A5CR2 | 1901-0518 | | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A5CR3 | 1901-0518 | | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A5CR4 | 1901-0518 | | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A5CR5 | 1902-0692 | 2 | DIODE:TC REFERENCE 6.3V 1% | 28480 | 1902-0692 |
| A5CR6 | 1901-0376 | 4 | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A5CR7 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A5IC1 | 1820-0253 | 1 | INTEGRATED CIRCUIT:DIGITAL ECL DUAL | 04713 | MC1035P |
| A5IC2 | 1820-0200 | 2 | IC:ECL QUAD EXCL. OR GATE | 04713 | MC 1030P |
| A5IC3 | 1820-0157 | 1 | IC:ECL DUAL 4-INPT OR/NOR CLOCK DRIVER | 04713 | MC 1023P |
| A5IC4 | 1820-0897 | 2 | IC:ECL QUAD 2-INPT AND GATE | 04713 | MC 1047B |
| A5IC5 | 1820-0200 | | IC:ECL QUAD EXCL. OR GATE | 04713 | MC 1030P |
| A5IC6 | 1820-0897 | | IC:ECL QUAD 2-INPT AND GATE | 04713 | MC 1047B |
| A5IC7 | 1820-0581 | 1 | IC:DIGITAL ECL DUAL AC-COUPLED J-K/F-F | 28480 | 1820-0581 |
| A5IC8 | 1858-0019 | | TSTR ARRAY:DUAL INDEP. DIFFERENTIAL | 02735 | CA 3054 |
| A5IC9 | 1826-0043 | 15 | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A5IC10 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A5IC11 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A5J2 | 1251-1636 | | CONNECTOR:SINGLE MALE CONTACT | 28480 | 1251-1636 |
| A5J2 | 0360-1715 | | TERMINAL:SOLDER STUD 0.040" SHANK DIA | 00000 | OBD |
| A5J3 | 1251-1636 | | CONNECTOR:SINGLE MALE CONTACT | 28480 | 1251-1636 |
| A5J3 | 0360-1715 | | TERMINAL:SOLDER STUD 0.040" SHANK DIA | 00000 | OBD |
| A5MP1 | 1200-0424 | 1 | SOCKET:IC BLK 14 CONTACT | 23880 | CSA2900-14B |
| A5Q1 | 1853-0086 | 1 | TSTR:SI PNP | 80131 | 2N5087 |
| A5Q2 | 1855-0082 | 2 | TSTR:SI FET P-CHANNEL | 28480 | 1855-0082 |
| A5Q3 | 1855-0082 | | TSTR:SI FET P-CHANNEL | 28480 | 1855-0082 |
| A5R1 | 0757-0280 | | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A5R2 | 0698-4469 | 1 | R:FXD FLM 1.15K OHM 1% 1/8W | 28480 | 0698-4469 |
| A5R3 | 0757-0420 | 4 | R:FXD MET FLM 750 OHM 1% 1/8W | 28480 | 0757-0420 |
| A5R4 | 0757-0427 | 14 | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R5 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R6 | 0757-0420 | | R:FXD MET FLM 750 OHM 1% 1/8W | 28480 | 0757-0420 |
| A5R7 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R8 | 0684-1231 | 2 | R:FXD COMP 12K OHM 10% 1/4W | 01121 | CB 1231 |
| A5R9 | 0757-0420 | | R:FXD MET FLM 750 OHM 1% 1/8W | 28480 | 0757-0420 |
| A5R10 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R11 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R12 | 0757-0420 | | R:FXD MET FLM 750 OHM 1% 1/8W | 28480 | 0757-0420 |
| A5R13 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R14 | 0698-4426 | 2 | R:FXD FLM 1580 OHM 1% 1/8W | 28480 | 0698-4426 |
| A5R15 | 0684-1811 | 4 | R:FXD COMP 180 OHM 10% 1/4W | 01121 | CB 1811 |
| A5R16 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R17 | 0698-3557 | 2 | R:FXD FLM 806 OHM 1% 1/8W | 28480 | 0698-3557 |
| A5R18 | 0698-4458 | 1 | R:FXD FLM 590 OHM 1% 1/8W | 28480 | 0698-4458 |
| A5R19 | 0698-4460 | 4 | R:FXD FLM 649 OHM 1% 1/8W | 28480 | 0698-4460 |
| A5R20 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R21 | 0698-4426 | | R:FXD FLM 1580 OHM 1% 1/8W | 28480 | 0698-4426 |
| A5R22 | 0684-1811 | | R:FXD COMP 180 OHM 10% 1/4W | 01121 | CB 1811 |
| A5R23 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R24 | 0698-3557 | | R:FXD FLM 806 OHM 1% 1/8W | 28480 | 0698-3557 |
| A5R25 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R26 | 0698-4460 | | R:FXD FLM 649 OHM 1% 1/8W | 28480 | 0698-4460 |
| A5R27 | 0698-4419 | 2 | R:FXD FLM 210 OHM 1% 1/8W | 28480 | 0698-4419 |
| A5R28 | 0698-4419 | | R:FXD FLM 210 OHM 1% 1/8W | 28480 | 0698-4419 |
| A5R29 | 0757-0450 | 2 | R:FXD MET FLM 22.1K OHM 1% 1/8W | 28480 | 0757-0450 |
| A5R30 | 0757-0429 | 2 | R:FXD MET FLM 1.82K OHM 1% 1/8W | 28480 | 0757-0429 |
| A5R31 | 2100-3123 | 5 | R:VAR CERMET 500 OHM 10% TYPE P 3/4W | 28480 | 2100-3123 |
| A5R32 | 0757-0450 | | R:FXD MET FLM 22.1K OHM 1% 1/8W | 28480 | 0757-0450 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A5R43 | 0698-7952 | 1 | R:FXD FLM 1804 OHM | 28480 | 0698-7952 |
| A5R44 | 0757-0429 | | R:FXD MET FLM 1.42K OHM 1% 1/8W | 28480 | 0757-0429 |
| A5R45 | 0757-0290 | 4 | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5R46 | 0698-7951 | 4 | R:FXD MET FLM 6190 OHM | 28480 | 0698-7951 |
| A5R47 | 0698-8068 | 2 | R:FXD FLM 4.99K OHM 0.25% 1/8W | 28480 | 0698-8068 |
| A5R48 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A5R49 | 2100-3123 | | R:VAR CERMET 500 OHM 10% TYPE P 3/4W | 28480 | 2100-3123 |
| A5R50 | 2100-3123 | | R:VAR CERMET 500 OHM 10% TYPE P 3/4W | 28480 | 2100-3123 |
| A5R51 | 0698-4460 | | R:FXD FLM 649 OHM 1% 1/8W | 28480 | 0698-4460 |
| A5R52 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5R53 | 0698-7951 | | R:FXD MET FLM 6190 OHM | 28480 | 0698-7951 |
| A5R54 | 0684-1231 | | R:FXD COMP 12K OHM 10% 1/4W | 01121 | CB 1231 |
| A5R55 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A5S1 | 3101-1637 | 2 | SWITCH:SLIDE DP4T | 28480 | 3101-1637 |
| A6 | 03575-66506 | 1 | BOARD ASSY:CURRENT | 28480 | 03575-66506 |
| A6C1 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 72982 | 8131-100-651-104Z |
| A6C2 | 0180-1746 | | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A6C3 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A6C4 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A6C5 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A6C6 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A6C7 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A6C8 | 0180-1746 | | C:FXD ELECT 15 UF 10% 20VDCW | 28480 | 0180-1746 |
| A6C9 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A6C10 - 13 | | | NOT ASSIGNED | | |
| A6C14, 15 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100 VDCW | 72982 | 8131-100-651-104Z |
| A6C16 | | | NOT ASSIGNED | | |
| A6CR1 | 1901-0518 | | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A6CR2 | 1901-0518 | | DIODE:HOT CARRIER | 28480 | 1901-0518 |
| A6CR3 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A6CR4 | 1901-0376 | | DIODE:SILICON 35V | 28480 | 1901-0376 |
| A6CR5 | 1902-0692 | | DIODE:TC REFERENCE 6.3V 1% | 28480 | 1902-0692 |
| A6IC1 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A6IC2 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A6IC3 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A6IC4 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A6J1 | 1251-3134 | | CONNECTOR:PHONO, SINGLE JACK | 28480 | 1251-3134 |
| A6MP1 | 1600-0248 | | SUPPORT:RT. ANGLE CONNECTOR | 28480 | 1600-0248 |
| A6Q1 | 1854-0345 | 2 | TSTR:SI NPN | 80131 | 2N5179 |
| A6Q2 | 1854-0345 | | TSTR:SI NPN | 80131 | 2N5179 |
| A6Q3 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A6Q4 | 1855-0081 | | TSTR:SI FET | 80131 | 2N5245 |
| A6Q5 | 1855-0081 | | TSTR:SI FET | 80131 | 2N5245 |
| A6Q6 | 1855-0081 | | TSTR:SI FET | 80131 | 2N5245 |
| A6R1 | 0684-1001 | 1 | R:FXD COMP 10 OHM 10% 1/4W | 28480 | 0684-1001 |
| A6R2 | 0757-0277 | 2 | R:FXD MET FLM 49.9 OHM 1% 1/8W | 28480 | 0757-0277 |
| A6R3 | 0757-0277 | | R:FXD MET FLM 49.9 OHM 1% 1/8W | 28480 | 0757-0277 |
| A6R4 | 0684-1811 | | R:FXD COMP 180 OHM 10% 1/4W | 01121 | CB 1811 |
| A6R5 | 0698-3512 | 2 | R:FXD FLM 1180 OHM 1% 1/8W | 28480 | 0698-3512 |
| A6R6 | 0698-4014 | 1 | R:FXD MET FLM 787 OHM 1% 1/8W | 28480 | 0698-4014 |
| A6R7 | 0698-3441 | | R:FXD MET FLM 215 OHM 1% 1/8W | 28480 | 0698-3441 |
| A6R8 | 0757-0434 | 2 | R:FXD MET FLM 3.65K OHM 1% 1/8W | 28480 | 0757-0434 |
| A6R9 | 0757-0434 | | R:FXD MET FLM 3.65K OHM 1% 1/8W | 28480 | 0757-0434 |
| A6R10 | 0684-3921 | | R:FXD COMP 3900 OHM 10% 1/4W | 01121 | CB 3921 |
| A6R11 | 0684-1521 | 4 | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A6R12 | 0684-3921 | | R:FXD COMP 3900 OHM 10% 1/4W | 01121 | CB 3921 |
| A6R13 | 0698-7951 | | R:FXD MET FLM 6190 OHM | 28480 | 0698-7951 |
| A6R14 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A6R15 | 0698-3516 | 3 | R:FXD FLM 6340 OHM 1% 1/8W | 28480 | 0698-3516 |
| A6R16 | 0698-3516 | | R:FXD FLM 6340 OHM 1% 1/8W | 28480 | 0698-3516 |
| A6R17 | 0698-7951 | | R:FXD MET FLM 6190 OHM | 28480 | 0698-7951 |
| A6R18 | 0757-0290 | | R:FXD MET FLM 6.19K OHM 1% 1/8W | 28480 | 0757-0290 |
| A6R19 | 2100-3123 | | R:VAR CERMET 500 OHM 10% TYPE P 3/4W | 28480 | 2100-3123 |
| A6R20 | 0698-8068 | | R:FXD FLM 4.99K OHM 0.25% 1/8W | 28480 | 0698-8068 |
| A6R21 | 2100-3123 | | R:VAR CERMET 500 OHM 10% TYPE P 3/4W | 28480 | 2100-3123 |
| A6R22 | 0698-4460 | | R:FXD FLM 649 OHM 1% 1/8W | 28480 | 0698-4460 |
| A6R23 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A6R24 | 0684-1811 | | R:FXD COMP 180 OHM 10% 1/4W | 01121 | CB 1811 |
| A6S1 | 3101-1637 | | SWITCH:SLIDE DP4T | 28480 | 3101-1637 |
| A7 | 03575-66507 | 1 | BOARD ASSY:CONTROL FILTER | 28480 | 03575-66507 |
| A7C1 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A7C2 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A7C3 | 0160-0156 | 4 | C:FXD MY 0.0039 UF 10% 200VDCW | 56289 | 192P39292-PTS |
| A7C4 | 0160-0164 | 2 | C:FXD MY 0.039 UF 10% 200VDCW | 56289 | 192P39392-PTS |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A7C5 | 0160-3826 | 4 | C:FXD POLY 0.39 UF 10% 50VDCW | 28480 | 0160-3826 |
| A7C6 | 0160-3501 | 4 | C:FXD POLY 4 UF 10% 50VDCW | 84411 | HEW 138 |
| A7C7 | 0160-0156 | | C:FXD MY 0.0039 UF 10% 200VDCW | 56289 | 192P39292-PTS |
| A7C8* | | | NOT ASSIGNED | | |
| A7C9 | 0160-0156 | | C:FXD MY 0.0039 UF 10% 200VDCW | 56289 | 192P39292-PTS |
| A7C10 | 0160-3501 | | C:FXD POLY 4 UF 10% 50VDCW | 84411 | HEW 138 |
| A7C11 | 0160-3826 | | C:FXD POLY 0.39 UF 10% 50VDCW | 28480 | 0160-3826 |
| A7C12 | 0160-0164 | | C:FXD MY 0.039 UF 10% 200VDCW | 56289 | 192P39392-PTS |
| A7C13 | 0160-0156 | | C:FXD MY 0.0039 UF 10% 200VDCW | 56289 | 192P39292-PTS |
| A7C14 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A7C15* | | | NOT ASSIGNED | | |
| A7C16 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A7C17 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A7C18 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A7C19 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A7C20 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A7C21 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A7CR1 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR2 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR3 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR4 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR5 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR6 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR7 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR8 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR9 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR10 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR11 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR12 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR13 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR14 | 1902-3190 | 8 | DIODE BREAKDOWN:13.0V 5% 400 MW | 28480 | 1902-3190 |
| A7CR15 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR16 | 1902-3190 | | DIODE BREAKDOWN:13.0V 5% 400 MW | 28480 | 1902-3190 |
| A7CR17 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A7CR18 | 1902-3190 | | DIODE BREAKDOWN:13.0V 5% 400 MW | 28480 | 1902-3190 |
| A7IC1 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A7IC2 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A7IC3 | 1820-0223 | 8 | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A7MP1 | 4040-0748 | 3 | EXTRACTOR:PC BOARD, BLACK | 28480 | 4040-0748 |
| A7MP2 | 4040-0755 | 1 | EXTRACTOR:PC BOARD, VIOLET | 28480 | 4040-0755 |
| A7Q1 | 1855-0368 | 24 | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q2 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q3 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q4 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q5 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q6 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q7 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q8 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q9 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q10 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q11 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q12 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A7Q13 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A7Q14 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A7Q15 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A7R1 | 0684-4751 | 3 | R:FXD COMP 4.7 MEGOHM 10% 1/4W | 01121 | CB 4751 |
| A7R2 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A7R3 | 0698-4525 | 2 | R:FXD FLM 187K OHM 1% 1/8W | 28480 | 0698-4525 |
| A7R4 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R5 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R6 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R7 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R8 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R9 | 0698-4432 | 2 | R:FXD FLM 2.1K OHM 1% 1/8W | 28480 | 0698-4432 |
| A7R10 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R11 | 0757-0472 | 2 | R:FXD MET FLM 200K OHM 1% 1/8W | 28480 | 0757-0472 |
| A7R12 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R13 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R14 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R15 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R16 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R17 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R18 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R19 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R20 | 0698-4481 | 2 | R:FXD FLM 16.5K OHM 1% 1/8W | 28480 | 0698-4481 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A7R21 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A7R22 | 0698-3459 | 2 | R:FXD MET FLM 383K OHM 1% 1/8W | 28480 | 0698-3459 |
| A7R23 | 0684-2221 | 2 | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A7R24 | | | NOT ASSIGNED | | |
| A7R25 | | | NOT ASSIGNED | | |
| A7R26 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R27 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R28 | 0684-4721 | 25 | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A7R29 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R30 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R31 | 0684-2231 | 7 | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A7R32 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R33 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A7R34 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8 | 03575-66508 | 1 | BOARD ASSY:FUNCTION SWITCH | 28480 | 03575-66508 |
| A8C1 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A8C2 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A8C3 | 0160-2204 | | C:FXD MICA 100PF 5% | 72136 | RDM15F101J3C |
| A8C4 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A8C5 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A8C6 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A8C7 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A8CR1 | 1902-3136 | 2 | DIODE BREAKDOWN:8.06V 5% 400 MW | 28480 | 1902-3136 |
| A8CR2 | 1902-3136 | | DIODE BREAKDOWN:8.06V 5% 400 MW | 28480 | 1902-3136 |
| A8CR3 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR4 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR5 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR6 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR7 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR8 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR9 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8CR10 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A8IC1 | 1826-0059 | | IC:LINEAR OPER. AMPL. | 12040 | LM 201AD |
| A8IC2 | 1826-0059 | | IC:LINEAR OPER. AMPL. | 12040 | LM 201AD |
| A8IC3 | 1826-0059 | | IC:LINEAR OPER. AMPL. | 12040 | LM 201AD |
| A8IC4 | 1820-0054 | 2 | IC:TTL QUAD 2-INPT NAND GATE | 01295 | SN7400N |
| A8IC5 | 1820-0511 | 3 | IC:TTL QUAD 2-INPT AND GATE | 01295 | SN7408N |
| A8IC6 | 1820-0068 | 2 | IC:TTL TRIPLE 3-INPUT POS NAND GATE | 12040 | SN7410N |
| A8MP1 | 4040-0748 | | EXTRACTOR:PC BOARD, BLACK | 28480 | 4040-0748 |
| A8MP2 | 4040-0747 | 2 | EXTRACTOR:PC BOARD, GRAY | 28480 | 4040-0747 |
| A8Q1 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q2 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q3 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q4 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q5 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q6 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q7 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q8 | 1855-0378 | 6 | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q9 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q10 | 1855-0378 | | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q11 | 1855-0378 | | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q12 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q13 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q14 | 1855-0378 | | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q15 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q16 | 1855-0378 | | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q17 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8Q18 | 1855-0378 | | TSTR:FET SI N-CHANNEL | 28480 | 1855-0378 |
| A8Q19 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A8R1 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8R2 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R3 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A8R4 | 0684-3331 | 2 | R:FXD COMP 33K OHM 10% 1/4W | 01121 | CB 3331 |
| A8R5 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R6 | 0698-8162 | 2 | R:FXD FLM 11.8K OHM 0.25% 1/8W | 28480 | 0698-8162 |
| A8R7 | 0698-3264 | 3 | R:FXD FLM 11.8K OHM 1% 1/8W | 28480 | 0698-3264 |
| A8R8 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R9 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A8R10 | 0757-0453 | 2 | R:FXD MET FLM 30.1K OHM 1% 1/8W | 28480 | 0757-0453 |
| A8R11 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A8R12 | 0698-7518 | 2 | R:FXD FLM 200 OHM 0.25% 1/8W | 28480 | 0698-7518 |
| A8R13 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8R14 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R15 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A8R16 | 0684-3331 | | R:FXD COMP 33K OHM 10% 1/4W | 01121 | CB 3331 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A8R17 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R18 | 0698-8162 | | R:FXD FLM 11.8K OHM 0.25% 1/8W | 28480 | 0698-8162 |
| A8R19 | 0698-3264 | | R:FXD FLM 11.8K OHM 1% 1/8W | 28480 | 0698-3264 |
| A8R20 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R21 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A8R22 | 0757-0453 | | R:FXD MET FLM 30.1K OHM 1% 1/8W | 28480 | 0757-0453 |
| A8R23 | 0757-0273 | | R:FXD MET FLM 3.01K OHM 1% 1/8W | 28480 | 0757-0273 |
| A8R24 | 0698-7518 | | R:FXD FLM 200 OHM 0.25% 1/8W | 28480 | 0698-7518 |
| A8R25 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8R26 | 0684-4731 | 3 | R:FXD COMP 47K OHM 10% 1/4W | 01121 | CB 4731 |
| A8R27 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R28 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A8R29 | 0698-6363 | 5 | R:FXD FLM 40K OHM 0.1% 1/8W | 28480 | 0698-6363 |
| A8R30 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R31 | 0698-6363 | | R:FXD FLM 40K OHM 0.1% 1/8W | 28480 | 0698-6363 |
| A8R32 | 0698-6363 | | R:FXD FLM 40K OHM 0.1% 1/8W | 28480 | 0698-6363 |
| A8R33 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R34 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R35 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R36 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8R37 | 0684-4731 | | R:FXD COMP 47K OHM 10% 1/4W | 01121 | CB 4731 |
| A8R38 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R39 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R40 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A8R41 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R42 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R43 | 2100-2514 | 1 | R:VAR CERMET 20K OHM 10% LIN 1/2W | 28480 | 2100-2514 |
| A8R44 | 0684-4751 | | R:FXD COMP 4.7 MEGOHM 10% 1/4W | 01121 | CB 4751 |
| A8R45 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R46 | 0698-6363 | | R:FXD FLM 40K OHM 0.1% 1/8W | 28480 | 0698-6363 |
| A8R47 | 0698-6363 | | R:FXD FLM 40K OHM 0.1% 1/8W | 28480 | 0698-6363 |
| A8R48 | 0684-2231 | | R:FXD COMP 22K OHM 10% 1/4W | 01121 | CB 2231 |
| A8R49 | 0684-4731 | | R:FXD COMP 47K OHM 10% 1/4W | 01121 | CB 4731 |
| A8R50 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R51 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R52 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A8R53 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A8R54 | 0684-1061 | | R:FXD COMP 10 MEGOHM 10% 1/4W | 01121 | CB 1061 |
| A8R55 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A8R56 | 0839-0026 | 2 | THERMISTOR:10K OHM 10% | 15801 | JA4112 |
| A8R57 | 0839-0026 | | THERMISTOR:10K OHM 10% | 15801 | JA4112 |
| A8R58 | 0698-4508 | 1 | R:FXD FLM 78.7K OHM 1% 1/8W | 28480 | 0698-4508 |
| A8R59 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9 | 03575-66509 | 1 | BOARD ASSY:OUTPUT FILTER | 28480 | 03575-66509 |
| A9C1 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A9C2 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A9C3 | 0160-3824 | 4 | C:FXD POLY 0.0039 UF 10% 50VDCW | 28480 | 0160-3824 |
| A9C4 | 0160-3825 | 2 | C:FXD POLY 0.039 UF 10% 50VDCW | 28480 | 0160-3825 |
| A9C5 | 0160-3826 | | C:FXD POLY 0.39 UF 10% 50VDCW | 28480 | 0160-3826 |
| A9C6 | 0160-3501 | | C:FXD POLY 4 UF 10% 50VDCW | 84411 | HEW 138 |
| A9C7 | 0160-3824 | | C:FXD POLY 0.0039 UF 10% 50VDCW | 28480 | 0160-3824 |
| A9C8* | | | NOT ASSIGNED | | |
| A9C9 | 0160-3824 | | C:FXD POLY 0.0039 UF 10% 50VDCW | 28480 | 0160-3824 |
| A9C10 | 0160-3501 | | C:FXD POLY 4 UF 10% 50VDCW | 84411 | HEW 138 |
| A9C11 | 0160-3826 | | C:FXD POLY 0.39 UF 10% 50VDCW | 28480 | 0160-3826 |
| A9C12 | 0160-3825 | | C:FXD POLY 0.039 UF 10% 50VDCW | 28480 | 0160-3825 |
| A9C13 | 0160-3824 | | C:FXD POLY 0.0039 UF 10% 50VDCW | 28480 | 0160-3824 |
| A9C14 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A9C15* | | | NOT ASSIGNED | | |
| A9C16 | 0140-0200 | | C:FXD MICA 390 PF 5% | 72136 | RDM15F391-J3C |
| A9C17 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A9C18 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A9C19 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A9C20 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A9CR1 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR2 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR3 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR4 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR5 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR6 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR7 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR8 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9CR9 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A9IC1 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A9IC2 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A9IC3 | 1826-0059 | | IC:LINEAR OPER. AMPL. | 12040 | LM201 AD |
| A9MP1 | 4040-0748 | | EXTRACTOR:PC BOARD, BLACK | 28480 | 4040-0748 |
| A9MP2 | 4040-0756 | 1 | EXTRACTOR:PC BOARD, WHITE | 28480 | 4040-0756 |
| A9Q1 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q2 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q3 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q4 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q5 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q6 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q7 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q8 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q9 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q10 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q11 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9Q12 | 1855-0368 | | TSTR:FET SI NPN N-CHANNEL | 28480 | 1855-0368 |
| A9R1 | 0684-4751 | | R:FXD COMP 4.7 MEGOHM 10% 1/4W | 01121 | CB 4751 |
| A9R2 | 0757-0427 | | R:FXD MET FLM 1.5K OHM 1% 1/8W | 28480 | 0757-0427 |
| A9R3 | 0698-4525 | | R:FXD FLM 187K OHM 1% 1/8W | 28480 | 0698-4525 |
| A9R4 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R5 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R6 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R7 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R8 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R9 | 0698-4432 | | R:FXD FLM 2.1K OHM 1% 1/8W | 28480 | 0698-4432 |
| A9R10 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R11 | 0757-0472 | | R:FXD MET FLM 200K OHM 1% 1/8W | 28480 | 0757-0472 |
| A9R12 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R13 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R14 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R15 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R16 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R17 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A9R18 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R19 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R20 | 0698-4481 | | R:FXD FLM 16.5K OHM 1% 1/8W | 28480 | 0698-4481 |
| A9R21 | 0757-0465 | | R:FXD MET FLM 100K OHM 1% 1/8W | 28480 | 0757-0465 |
| A9R22 | 0698-3459 | | R:FXD MET FLM 383K OHM 1% 1/8W | 28480 | 0698-3459 |
| A9R23 | 0757-0280 | | R:FXD MET FLM 1K OHM 1% 1/8W | 28480 | 0757-0280 |
| A9R24 | 0698-8095 | 2 | R:FXD MET FLM 2.94 MEGOHM 1.0% 1/2W | 28480 | 0698-8095 |
| A9R25 | 0698-8095 | | R:FXD MET FLM 2.94 MEGOHM 1.0% 1/2W | 28480 | 0698-8095 |
| A9R26 | 0698-8094 | 1 | R:FXD MET FLM 1.82 MEGOHM 1.0% 1/2W | 28480 | 0698-8094 |
| A9R27 | 2100-3103 | 1 | R:VAR CERMET 10K OHM 10% TYPE P 3/4W | 28480 | 2100-3103 |
| A10 (OPTION 001, 002 ONLY, SAME AS A9) | 03575-66509 | | BOARD ASSY: OUTPUT FILTER | 28480 | 03575-66509 |
| A11 | 03575-66511 | 1 | BOARD ASSY: PHASE LOGIC | 28480 | 03575-66511 |
| A11C1 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A11C2 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A11C3 | 0180-0229 | | C:FXD ELECT 33 UF 10% 10VDCW | 28480 | 0180-0229 |
| A11C4 | 0160-3622 | | C:FXD CER 0.1 UF +80-20% 100VDCW | 28480 | 0160-3622 |
| A11C5 | 0160-2055 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023F101F103ZS22-CDH |
| A11C6* | | | NOT ASSIGNED | | |
| A11C7* | | | NOT ASSIGNED | | |
| A11C8* | | | NOT ASSIGNED | | |
| A11C9* | | | NOT ASSIGNED | | |
| A11CR1 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR2 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR3 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR4 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR5 | 1910-0016 | 5 | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A11CR6 | 1910-0016 | | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A11CR7 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR8 | 1910-0016 | | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A11CR9 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR10 | 1910-0016 | | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A11CR11 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11CR12 | 1901-0040 | | DIODE:SILICON 50MA 30WV | 07263 | FDG1088 |
| A11IC1 | 1820-0583 | 3 | IC:TTL LP QUAD 2-INPT NAND GATE | 12040 | DM74L00N |
| A11IC2 | 1820-0587 | 1 | IC:TTL LP TRIPLE 3-INPT NAND GATE | 12040 | DM74L10N |
| A11IC3 | 1820-0583 | | IC:TTL LP QUAD 2-INPT NAND GATE | 12040 | DM74L00N |
| A11IC4 | 1820-0583 | | IC:TTL LP QUAD 2-INPT NAND GATE | 12040 | DM74L00N |
| A11IC5 | 1820-0584 | 1 | IC:TTL LP QUAD 2-INPT NOR GATE | 12040 | DM74L02N |
| A11IC6 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A11IC7 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A11IC8 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |
| A11IC9 | 1826-0043 | | IC:LINEAR OPERATIONAL AMPLIFIER | 28480 | 1826-0043 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A11MP1 | 4040-0749 | 5 | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A11Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A11Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A11R1 | 0684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A11R2 | 0684-2251 | 1 | R:FXD COMP 2.2 MEGOHM 10% 1/4W | 01121 | CB 2251 |
| A11R3 | | | NOT ASSIGNED | | |
| A11R4 | 0698-3516 | | R:FXD FLM 6340 OHM 1% 1/8W | 28480 | 0698-3516 |
| A11R5 | 0698-3496 | 1 | R:FXD FLM 3.57K OHM 1% 1/8W | 28480 | 0698-3496 |
| A11R6 | 0757-0470 | 1 | R:FXD MET FLM 162K OHM 1% 1/8W | 28480 | 0757-0470 |
| A11R7 | 0684-5621 | 17 | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R8 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R9 | 0698-3264 | | R:FXD FLM 11.8K OHM 1% 1/8W | 28480 | 0698-3264 |
| A11R10 | 0757-0410 | | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A11R11 | 0757-0289 | 1 | R:FXD MET FLM 13.3K OHM 1% 1/8W | 28480 | 0757-0289 |
| A11R12 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R13 | 0684-5631 | 1 | R:FXD COMP 56K OHM 10% 1/4W | 01121 | CB 5631 |
| A11R14 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A11R15 | 0698-3193 | 1 | R:FXD FLM 10K OHM 0.25% 1/8W | 28480 | 0698-3193 |
| A11R16 | 0698-8025 | 2 | R:FXD FLM 1.91K OHM 0.25% 1/8W | 28480 | 0698-8025 |
| A11R17 | 0698-4494 | 1 | R:FXD FLM 35.7K OHM 1% 1/8W | 28480 | 0698-4494 |
| A11R18 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R19 | 0698-8024 | 1 | R:FXD FLM 3.09K OHM 0.25% 1/8W | 28480 | 0698-8024 |
| A11R20 | 0698-8025 | | R:FXD FLM 1.91K OHM 0.25% 1/8W | 28480 | 0698-8025 |
| A11R21 | 0698-4488 | 1 | R:FXD FLM 26.7K OHM 1% 1/8W | 28480 | 0698-4488 |
| A11R22 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R24 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A11R25 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R26 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A12A (STD MODEL 3575A) | 03575-66550 | | BOARD ASSY: PANEL METER | 28480 | 03575-66550 |
| A12C1 | 0180-2419 | | C: FXD TA 470 UF 20% 10 VDCW | 56289 | 109D477X0010F2 |
| A12C2, C3 | 0180-1835 | | C: FXD TA 68 UF 20% 15 VDCW | 56289 | 150D686X0015R2-DYS |
| A12J1 | 1251-2955 | | CONN: PC (2 X 25) 50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A12L1 | 9100-3337 | | COIL: FXD 100 UH 20% 10 KHZ | 99800 | BP2650 |
| A12MP1 | 4040-0749 | | EXTRACTOR: PC BOARD BROWN | 28480 | 4040-0749 |
| A12MP2 | 4040-0750 | | EXTRACTOR: PC BOARD RED | 28480 | 4040-0750 |
| A12R1 | 0684-6805 | | R: FXD COMP 68 OHM 10% 1/4W | 01121 | CB6805 |
| A12R2 | | | NOT ASSIGNED | | |
| A12R3-R8 | 0684-6805 | | R: FXD COMP 68 OHM 10% 1/4W | 01121 | CB6805 |
| A12R9 | | | NOT ASSIGNED | | |
| A12R10 | 0684-6805 | | R: FXD COMP 68 OHM 10% 1/4W | 01121 | CB6805 |
| A12R11 | | | NOT ASSIGNED | | |
| A12R12 | 0684-6805 | | R: FXD COMP 68 OHM 10% 1/4W | 01121 | CB6805 |
| A12R13-R15 | | | NOT ASSIGNED | | |
| A12R16, R17 | 0698-8062 | | R: FXD COMP 4.7 OHM 10% | 01121 | CB OBD |
| A12U1, U2 | 1820-0668 | | IC: TTL HEX DRIVER | 01295 | SN7407N |
| A12B (OPTIONS 001-003) | 03575-66551 | | BOARD ASSY: PANEL METER | 28480 | 03575-66551 |
| A12C1 | 0180-2419 | | C: FXD TA 470 UF 20% 10 VDCW | 56289 | 190D477X0010F2 |
| A12C2, C3 | 0180-1835 | | C: FXD TA 68 UF 20% 15 VDCW | 56289 | 150D686X0015R2-DYS |
| A12C4-C11 | 0150-0069 | | C: FXD .001 UF +80 -20% 500 VDCW | 28480 | 0150-0069 |
| A12C12 | 0180-2419 | | C: FXD TA 470 UF 20% 10 VDCW | 56289 | 190D477X0010F2 |
| A12J1, J2 | 1251-2955 | | CONN: PC (2 X 25) 50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A12L1, L2 | 9100-3337 | | COIL: FXD 100 UH 20% 10 KHZ | 99800 | BP2650 |
| A12MP1 | 4040-0749 | | EXTRACTOR: PC BOARD BROWN | 28480 | 4040-0749 |
| A12MP2 | 4040-0750 | | EXTRACTOR: PC BOARD RED | 28480 | 4040-0750 |
| A12R1-R15 | 0684-6805 | | R: FXD COMP 68 OHM 10% 1/4W | 01121 | CB6805 |
| A12R16, R17 | 0698-8062 | | R: FXD COMP 4.7 OHM 10% | 01121 | CB OBD |
| A12U1-U4 | 1820-0668 | | IC: TTL HEX DRIVER | 01295 | SN7407N |
| A12U5, U6 | 1820-1195 | | IC: TTL QUAD FLIP-FLOP | 01295 | SN74LS175 |
| A13 | 03575-66513 | 1 | BOARD ASSY:PANEL SWITCH | 28480 | 03575-66513 |
| A13CR1 | 1901-0025 | 14 | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A13S1 | 3100-2726 | 3 | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |
| A13S2 | 3100-2728 | 1 | SWITCH:ROTARY 4-POSITION | 28480 | 3100-2728 |
| A13S3 | 3100-2727 | 1 | SWITCH:ROTARY 3-POSITION | 28480 | 3100-2727 |
| A13S4 | 3100-2726 | | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A13S5 | 3100-2726 | | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |
| A14 | 03575-66514 | 1 | BOARD ASSY:POWER SUPPLY | 28480 | 03575-66514 |
| A14C1 | 0150-0071 | 5 | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C2 | 0160-2207 | 7 | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C3 | 0180-1835 | | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A14C4 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C5 | 0180-1835 | | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A14C6 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C7 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C8 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C9 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C10 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C11 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C12 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C13 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C14 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C15 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C16 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C17 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C18 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C19 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14CR1 | | | NOT ASSIGNED | | |
| A14CR2 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR3 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR4 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR5 | 1902-0025 | 2 | DIODE,BREAKDOWN:10.0V 5% 400 MW | 28480 | 1902-0025 |
| A14CR6 | 1902-0777 | 1 | DIODE:BREAKDOWN 6.2V 5% | 04713 | 1N825 |
| A14CR7 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR8 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR10 | 1902-0025 | | DIODE,BREAKDOWN:10.0V 5% 400 MW | 28480 | 1902-0025 |
| A14CR11 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR12 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR13 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR14 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR15 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR16 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR17 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR18 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR19 THRU CR22 | 1901-0028 | | DIODE:PWR RECT. 75A DO-29 | 04713 | SP1358-9 |
| A14IC1 THRU C3 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC4 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC5 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC6 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC7 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14MP1 | 4040-0749 | | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A14MP2 | 4040-0752 | 1 | EXTRACTOR:PC BOARD, YELLOW | 28480 | 4040-0752 |
| A14MP3 | 1205-0033 | 4 | HEAT SINK:SEMICONDUCTOR | 05820 | 207-CB |
| A14Q1 | 1854-0404 | 3 | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q2 | 1853-0010 | 4 | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q3 | 1854-0226 | 2 | TSTR:SI NPN | 80131 | 2N4384 |
| A14Q4 | 1854-0404 | | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q5 | 1854-0226 | | TSTR:SI NPN | 80131 | 2N4384 |
| A14Q6 | 1854-0404 | | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q7 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q8 | 1853-0051 | 4 | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q9 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q10 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q11 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q12 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q13 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14R1 | 0811-3079 | 3 | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R2 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R3 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R4 | 0698-3512 | | R:FXD FLM 1180 OHM 1% 1/8W | 28480 | 0698-3512 |
| A14R5 | 0698-8061 | 4 | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R6 | 2100-1758 | 1 | R:VAR WW 1K OHM 5% TYPE V 1W | 28480 | 2100-1758 |
| A14R7 | 0698-8039 | 1 | R:FXD MET FLM 8.87K OHM 0.1% 1/8W | 28480 | 0698-8039 |
| A14R8 | 0811-3079 | | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R9 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R10 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R11 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R12 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R13 | 0811-3056 | 2 | R:FXD WW 0.24 OHM 5% 1/2W | 28480 | 0811-3056 |
| A14R14 | 0757-0284 | | R:FXD MET FLM 150 OHM 1% 1/8W | 28480 | 0757-0284 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A14R15 | 0698-3279 | 2 | R:FXD MET FLM 4990 OHM 1% 1/8W | 28480 | 0698-3279 |
| A14R16 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R17 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R18 | 0698-3153 | 1 | R:FXD MET FLM 3.83K OHM 1% 1/8W | 28480 | 0698-3153 |
| A14R19 | 0757-0444 | 2 | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A14R20 | 0811-2771 | | R:FXD WW 0.1K OHM 3% 3W | 01738 | RS2B-95 |
| A14R21 | 0757-0284 | | R:FXD MET FLM 150 OHM 1% 1/8W | 28480 | 0757-0284 |
| A14R22 | 0698-3279 | | R:FXD MET FLM 4990 OHM 1% 1/8W | 28480 | 0698-3279 |
| A14R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R24 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R25 | 0684-3321 | 1 | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A14R26 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R27 | 0698-8058 | 1 | R:FXD FLM 5.90K OHM 0.25% 1/8W | 28480 | 0698-8058 |
| A14R28 | 0811-3079 | | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R29 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R30 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R31 | 0698-3258 | 1 | R:FXD MET FLM 5.36K OHM 1% 1/8W | 28480 | 0698-3258 |
| A14R32 | 0757-0444 | | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A14R33 | 0811-3071 | 4 | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R34 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R35 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R36 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R37 | 0698-8059 | 2 | R:FXD FLM 4.32K OHM 0.1% 1/8W | 28480 | 0698-8059 |
| A14R38 | 0698-8060 | 2 | R:FXD FLM 8.64K OHM 0.1% 1/8W | 28480 | 0698-8060 |
| A14R39 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R40 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R41 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R42 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R43 | 0698-8059 | | R:FXD FLM 4.32K OHM 0.1% 1/8W | 28480 | 0698-8059 |
| A14R44 | 0698-8060 | | R:FXD FLM 8.64K OHM 0.1% 1/8W | 28480 | 0698-8060 |
| A14R45 | | | NOT ASSIGNED | | |
| A14R46 | | | NOT ASSIGNED | | |
| A14R47 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R48 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A15 | 03575-66515 | 1 | BOARD ASSY:POWER SUPPLY(MOTHER BD) | 28480 | 03575-66515 |
| A15C1 | 0180-2384 | 1 | C:FXD AL ELECT DUAL 3500/1200 UF 15/25V | 56289 | 968D20105 |
| A15C2 | 0180-2388 | 1 | C:FXD AL ELECT DUAL 3500/1200 UF 15/25V | 28480 | 0180-2388 |
| A15C3 | 0180-2394 | 1 | C:FXD AL ELECT 3000 UF +100-10% 10VDCW | 56289 | 68D10359 |
| A15CR1 | 1901-0028 | 12 | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR2 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR3 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR4 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR5 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR6 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR7 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR8 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR9 | 1901-0200 | | DIODE:SILICON 3A 100PIV | 02735 | 1N4998 |
| A15CR10 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR11 | 1901-0200 | | DIODE:SILICON 3A 100PIV | 02735 | 1N4998 |
| A15CR12 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15Q1 | 1854-0072 | 3 | TSTR:SI NPN | 80131 | 2N3054 |
| A15Q2 | 1854-0072 | | TSTR:SI NPN | 80131 | 2N3054 |
| A15Q3 | 1854-0063 | 2 | TSTR:SI NPN | 80131 | 2N3055 |
| A15Q4 | 1854-0063 | | TSTR:SI NPN | 80131 | 2N3055 |
| A15Q5 | 1854-0072 | | TSTR:SI NPN | 80131 | 2N3054 |
| A15XA14A | 1251-2034 | 1 | CONNECTOR: PC EDGE (2 X 10) 20 CONTACT | 71785 | 252-10-30-300 |
| A16A(STD & OPT 001 | 03575-26516 | | BOARD ASSY: INTERFACE SUBSTITUTION | 28480 | 03575-26516 |
| A16B(OPT 002 ONLY) | 03575-66552 | 1 | BOARD ASSY:INTERFACE NEGATIVE | 28480 | 03575-66542 |
| A16C1 | 0160-2964 | | C:FXD .01 UF 25 V | 28480 | 0160-2964 |
| A16C2 THRU C6 | | | NOT ASSIGNED | | |
| A16C7 | 0150-0050 | 4 | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C8 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C9 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C0678102E102ZS26-CDH |
| A16C10 | 0180-0309 | 3 | C:FXD ELECT 4.7 UF 10V | 28480 | 0180-0309 |
| A16C11 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C12 | 0180-0309 | | C:FXD ELECT 4.7 UF 20% 10VDCW | 56289 | 150D475X0010A2-DYS |
| A16C13 | 0160-3658 | 1 | C:FXD POLY 10 UF 10% 50VDCW | 28480 | 0160-3658 |
| A16C14 | 0180-0291 | | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A16C15 | 0180-0291 | | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A16CR1 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A16CR2 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A16CR3 | 1901-0040 | | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A16CR4-CR6 | 1901-0040 | 1 | DIODE: SILICON 50MA 30WV | 07263 | FDG1088 |
| A16IC1 | 1820-1112 | 1 | IC: DIGITAL | 01295 | SN74LS74N |
| A16IC2 THRU IC7 | 1820-1195 | 6 | IC: DIGITAL | 01295 | SN74LS175N |
| A16IC8 THRU IC11 | 1820-0471 | 4 | IC: TTL HEX INVERTER DRIVER | 01295 | SN7406N |
| A16IC12 | 1820-0174 | 2 | IC: TTL HEX INVERTER | 01295 | SN7404N |
| A16IC13 | 1820-0506 | 2 | IC:DIGITAL 2-INPT,4-BIT MULTIPLEXER | 18324 | N8266B |
| A16IC14 | 1820-0506 | | IC:DIGITAL 2-INPT,4-BIT MULTIPLEXER | 18324 | N8266B |
| A16IC15 | 1820-0515 | 1 | IC:TTL DUAL RE-TRIG/RE-SET MONO-MULTI | 07263 | U7B9602S9X |
| A16IC16 | 1820-0068 | | IC:TTL TRIPLE 3-INPUT POS NAND GATE | 12040 | SN7410N |
| A16IC17 | 1820-0054 | | IC:TTL QUAD 2-INPT NAND GATE | 01295 | SN7400N |
| A16IC18 | 1820-0174 | | IC: TTL HEX INVERTER | 01295 | SN7404N |
| A16MP1 | 4040-0754 | 1 | EXTRACTOR:PC BOARD, BLUE | 28480 | 4040-0754 |
| A16MP2 | 4040-0749 | | EXTRACTOR: PC BOARD, BROWN | 28480 | 4040-0749 |
| A16Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q3 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q4 | 1854-0226 | 1 | TSTR:SI NPN | 80131 | 2N4384 |
| A16Q5 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q6 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q7 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q8 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q9 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q10 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16R1 | 0683-4725 | | R: FXD 4.75K 5% | 28480 | 0683-4725 |
| A16R2 | 0683-5625 | | R: FXD 5.6K 5% .25W | 01121 | CB 5625 |
| A16R3 | | | NOT ASSIGNED | | |
| A16R4 | | | NOT ASSIGNED | | |
| A16R5 | 1810-0041 | 4 | R:NETWORK,8 RES. 2.7K OHM 5% | 28480 | 1810-0041 |
| A16R6 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R7 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R8 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R9 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R10 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R11 | 0757-0467 | 1 | R:FXD COMP 121K OHM 1% 1/8W | 28480 | 0757-0467 |
| A16R12 | 0683-1255 | 1 | R:FXD COMP 1.2 MEGOHM 5% 1/4W | 01121 | CB 1255 |
| A16R13 | 0683-1265 | 1 | R:FXD COMP 12 MEGOHM 5% 1/4W | 01121 | CB 1265 |
| A16R14 | 0698-3228 | 2 | R:FXD MET FLM 49.9K OHM 1% 1/8W | 28480 | 0698-3228 |
| A16R15 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R16 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R17 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R18 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R19 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R20 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R21 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R22 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R24 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R25 | 0698-3260 | 1 | R:FXD FLM 464K OHM 1% 1/8W | 28480 | 0698-3260 |
| A16R26 | 0698-3228 | | R:FXD MET FLM 49.9K OHM 1% 1/8W | 28480 | 0698-3228 |
| A16R27 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R28 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R29 | 0757-0444 | 1 | R:FXD FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A16R30 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R31 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A16R32 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A16R33 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R34 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R35 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R36 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R37 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R38 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R39 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R40 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R41 THRU R43 | 1810-0041 | | R: NETWORK, 8 RES. 2.7K OHM 5% | 28480 | 1810-0041 |
| A16XA19 | 1251-2955 | | CONNECTOR:PC (2 X 25)50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A16C | 03575-66553 | | BOARD ASSY: INTERFACE POSITIVE<br>(THIS ASSEMBLY IS USED WITH THE OPTION 003 ONLY. THE PARTS LIST IS IDENTICAL TO A16B EXCEPT FOR THE PART NO. CHANGE OF A16IC8-IC11 BELOW.) | 28480 | 03575-66543 |
| A16IC8 THRU IC11 | 1820-0668 | | IC: TTL HEX DRIVER | 01295 | SN7407N |
| A17 | 03575-66517 | 1 | BOARD ASSY:MOTHER | 28480 | 03575-66517 |
| A17XA1 | 1251-1604 | 9 | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA2 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA3 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A17XA4 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA5 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA6 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA7 | 1251-1365 | 4 | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 |
| A17XA8 | 1251-1365 | | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 |
| A17XA9 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA10 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA11 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA12 | 1251-1365 | | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 |
| A17XA13 | 1251-1633 | 1 | CONNECTOR:PC(1 X 15) 15 CONTACT | 71785 | 252-15-30-310 |
| A17XA14 | 1251-1632 | 1 | CONNECTOR: PC 1 X 12 CONTACT | 71785 | 252-12-30-310 |
| A17XA16 | 1251-1365 | | CONN PC 44 (2 X 22) CONTACTS | 71785 | 252-22-30-300 |
| A18 | 0960-0444 | 1 | PWR MODULE, UNFILTERED | 28480 | 0960-0444 |
| A19(OPT 002, 003 | 03575-66519 | 1 | BOARD ASSY:INTERFACE CONNECTOR | 28480 | 03575-66519 |
| A19J1 | 1251-0087 | 1 | CONNECTOR:FEMALE 50-PIN MINAT | 28480 | 1251-0087 |
| A19MP1 | 03575-01208 | 1 | BRACKET:INTERFACE CONNECTOR | 28480 | 03575-01208 |
| A19MP2 | 1530-1698 | 1 | SUPPORT:PC BOARD | 28480 | 1530-1698 |
| A20, 21, 22 | 5060-9188 OR | 1 | PANEL METER ASSEMBLY (3575A STD, OPTION 001) | 28480 | 5060-9188 OR |
| | 5060-9127 | 1 | PANEL METER ASSEMBLY (3575A OPTIONS 002 OR 003) | 28480 | 5060-9127 |
| A20 | 5061-0747 OR | 1 | PANEL METER MOTHER BD ASSY (PART OF 5060-9188) | 28480 | 5061-0747 |
| | 5061-0741 | 1 | PANEL METER MOTHER BD W/EXT. TRIGGER ASSY (PART OF 5060-9127) | 28480 | 5061-0741 |
| A20C1, C2 • | 0160-2094 | 2 | C:FXD 200 PF | 28480 | 0160-2094 |
| A20C3 | 0180-0116 | 1 | C:FXD 6.8 UF 10% 35VDC | 56289 | 150D685X903582 |
| A20C4, C5 | 0140-0234 | 2 | C:FXD 500 PF 1% 300WVDC | 72136 | DM15F501F0300WV1C |
| A20C6 | 0160-4040 | 1 | C:FXD 1000 PF | 28480 | 0160-4040 |
| A20C7• | | 1 | C: FXD 6.8 UF, 6V | 56289 | 150D685X0006A2 |
| A20CR1• | 1901-0518 | 1 | DIODE: SCHOTTKEY | 28480 | 1901-0518 |
| A20CR2 | 1902-0686 | 1 | DIODE: BKDN 6.2V | 04713 | 1N825 |
| A20Q1 • | 1854-0071 | 1 | TSTR:NPN SI | 28480 | 1854-0071 |
| A20R1, R2• | 0683-5125 | 2 | R:FXD 5.1K | 01121 | CB5125 |
| A20R3• | 0683-1025 | 1 | R:FXD 1K | 01121 | CB1025 |
| A20R4• | 0683-1035 | 1 | R:FXD 10K | 01121 | CB1035 |
| A20R5 | 0698-3515 | 1 | R:FXD 5.9K 1% 1/8W | 16299 | C4-1/8-TO-5901-F |
| A20R6 | 0698-4488 | 1 | R:FXD 26.7K 1% 1/8W | 24546 | C4-1/8-TO-2672-F |
| A20R7 | 0698-4462 | 1 | R:FXD 768 OHM 1% 1/8W | 24546 | C4-1/8-TO-768A-F |
| A20R8 - 10 | 0683-7505 | 3 | R:FXD 75 OHM 5% 1/4W | 01121 | CB7505 |
| A20U1 • | 1820-0583 | 1 | IC:DIGITAL | 27014 | DM74L00N |
| A20U2 • | 1820-0595 | 1 | IC:DIGITAL | 27014 | DM74L73N |
| A20U3 | 1826-0119 | 1 | IC:ANALOG | 18324 | NE555T |
| | 1200-0462 | 20 | SOCKET:IC | 24995 | 3-116141-2 |

•Contained on the 5061-0736 assembly only.
•Contained on the 5061-0739 assembly only.
•Components designated by •are only contained on 5061-0741 Mother Board Assy.

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A21 | 5061-0740 | 1 | PANEL METER DISPLAY BD ASSY | 28480 | 5061-0740 |
| A21DS2-DS10 | 1990-0419 | 9 | DIO:LIGHT EMITTING | 28480 | 1990-0419 |
| A21Q1-Q6 | 1853-0016 | 6 | TSTR:SI PNP | 28480 | 1853-0016 |
| A21R1-R7 | 0683-7505 | 7 | R:FXD 75 OHM 5% 1/4W | 01121 | CB7505 |
| A21R8-R11 | 0683-5115 | 5 | R:FXD 510 OHM 5% 1/4W | 01121 | CB5115 |
| A21R12 | 0683-1025 | 1 | R:FXD 1K 5% 1/4W | 01121 | CB1025 |
| A21R13 | 0683-5115 | | R:FXD 510 OHM 5% 1/4W | 01121 | CB5115 |
| A21R14 | 0683-1015 | 1 | R:FXD 100 OHM 5% 1/4W | 01121 | CB1015 |
| A21R15 | 0683-3015 | 1 | R:FXD 300 OHM 5% 1/4W | 01121 | CB3015 |
| A21R16 | 0683-3005 | 1 | R:FXD 30 OHM 5% 1/4W | 01121 | CB3005 |
| A21U1 | 1820-0995 | 1 | IC:DIGITAL DECODER | 01295 | SN7447AN |
| A21U2-U4 | 1990-0490 | 3 | DISPLAY:NUMERIC | 28480 | 1990-0490 |
| A21U5 | 1990-0491 | 1 | DISPLAY:POLARITY/OVERRANGE | 28480 | 1990-0491 |
| A21U6 | 1820-0471 | 1 | IC:HEX INVERTERS BUFFERS/DRIVERS | 01295 | SN7406N |
| A22 | 5061-0736 | 1 | PANEL METER A/D BD ASSY | 28480 | 5061-0736 |
| | OR | | (PART OF 5060-9188) | | OR |
| | 5061-0739 | 1 | PANEL METER A/D BD ASSY (PART OF 5060-9127) | 28480 | 5061-0739 |
| A22C1 * | 0160-0170 | 1 | C:FXD .22 UF 25WVDC | 28480 | 0160-0170 |
| A22C2 * | 0160-4243 | 1 | C:FXD .022 UF 10% 50V | 84411 | HEW249 |
| A22C3 | 0160-4244 | 1 | C:FXD .1 UF 10% 50WVDC | 84411 | HEW249 |
| A22C4 | 0121-0178 | 1 | C: V TRMR 200 V | 00865 | 304322 15/60PF N1500 |
| A22C5* | 0140-0205 | 1 | C: FXD 62 PF 5% 300WVDC | 72136 | DM15E62050300WV1CR |
| A22C6 • | 0160-0127 | 1 | C: FXD 1 UF 25WVDC | 28480 | 0150-0121 |
| A22CR1 | 1902-3149 | 1 | DIODE: ZENER 9.09 V | 04713 | SZ10939-170 |
| A22CR2 | 1901-0040 | 1 | DIODE: SI 50MA 30 V | 28480 | 1901-0040 |
| A22Q1 | 1855-0309 | 1 | TSTR:MOSFET P-CHAN E-MODE SI | 04713 | 2N4352 |
| A22Q2 | 1853-0036 | 1 | TSTR:PNP SI | 28480 | 1853-0036 |
| A22R1 | 0698-8312 | 1 | R:FXD 499K 0.5% 1/8W | 30983 | MF4C1/8-T2-4993-D |
| A22R2 | 0698-6914 | 2 | R:FXD 55.6K 0.5% 1/8W | 19701 | MF4C1/8-T2-5562-D |
| A22R3 | 0698-4486 | 1 | R:FXD 24.9K 1% 1/8W | 24546 | C4-1/8-TO-2492-F |
| A22R4 | 0698-6388 | 1 | R:FXD 70K 1% 1/8W | 19701 | MD4C1/8-T9-7002-F |
| A22R5 | 2100-1738 | 1 | R:VAR 10K 5% | 19701 | ET50W103 |
| A22R6 | 0698-7082 | 1 | R:FXD 100K 1% 1/8W | 19701 | MF4C1/8-T9-1003-F |
| A22R7 | 0698-6360 | 1 | R:FXD 10K 0.1% 1/8W | 19701 | MF4C1/8-T9-1002-B |
| A22R8 | 0698-6914 | | R:FXD 55.6K 0.5% 1/8W | 19701 | MF4C1/8-T2-5562-D |
| A22R9, R10 | 0683-5125 | 2 | R:FXD 5.1K 5% 1/4W | 01121 | CB5125 |
| A22R11 | 0683-1235 | 1 | R:FXD 12K 5% 1/4W | 01121 | CB1235 |
| A22R12 • | 0683-2435 | 1 | R:FXD 24K 5% 1/4W | 01121 | CB2435 |
| A22U1 | 1826-0195 | 1 | IC: ANALOG PROCESSOR | 28480 | 1826-0195 |
| A22U2 | 1820-1252 | 1 | IC: DIGITAL PROCESSOR (16 PIN) | 28480 | 1820-1252 |
| | OR | | (PART OF 5061-0736) | | OR |
| | 1820-1474 | 1 | IC: DIGITAL PROCESSOR (28 PIN) (PART OF 5061-0739) | 28480 | |
| A22U3 | 1820-0944 | 1 | IC:DIGITAL, TRIPLE 3-INPUT NOR GATE | 28480 | 1820-0944 |
| | 03431-01201 | 2 | BRKT:MTG | | |

Contained on the 5061-0736 assembly only.
Contained on the 5061-0739 assembly only.

•Contained on the 5061-0736 assembly only.
•Contained on the 5061-0739 assembly only.

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | CHASSIS MOUNTED COMPONENTS | | |
| C1 | 0160-3441 | 2 | C: FXD CER 0.002 UF 20% 3 K VDCW | 71590 | DD30-202 |
| C2 | 0160-3441 | | C: FXD CER 0.002 UF 20% 3 K VDCW | 71590 | DD30-202 |
| F1 | 2110-0339 | 1 | FUSE: SLOW BLOW 0.6 A, 250 V (115 V OPERATION) | | |
| F1 | 2110-0044 | 1 | FUSE: SLOW BLOW 0.3 A, 250 V (230 V OPERATION) | | |
| J1 | | | CONNECTOR: INPUT (P/O W1) | | |
| J2 | | | CONNECTOR: INPUT (P/O W2) | | |
| J3 | 1250-0083 | 2 | CONNECTOR: RF | 77068 | 30624-1 |
| J4 | 1250-0083 | | CONNECTOR: RF | 77068 | 30624-1 |
| J5 | 1510-0076 | 1 | POST: BINDING JADE GRAY | 28480 | 1510-0076 |
| S1 | 3101-0896 | 1 | SWITCH: TOGGLE | 28480 | 3101-0896 |
| S2 | 3101-1179 | 1 | SWITCH: TOGGLE | 28480 | 3101-1179 |
| T1 | 9100-3402 | 1 | XFMR: POWER | 28480 | 9100-3237 |

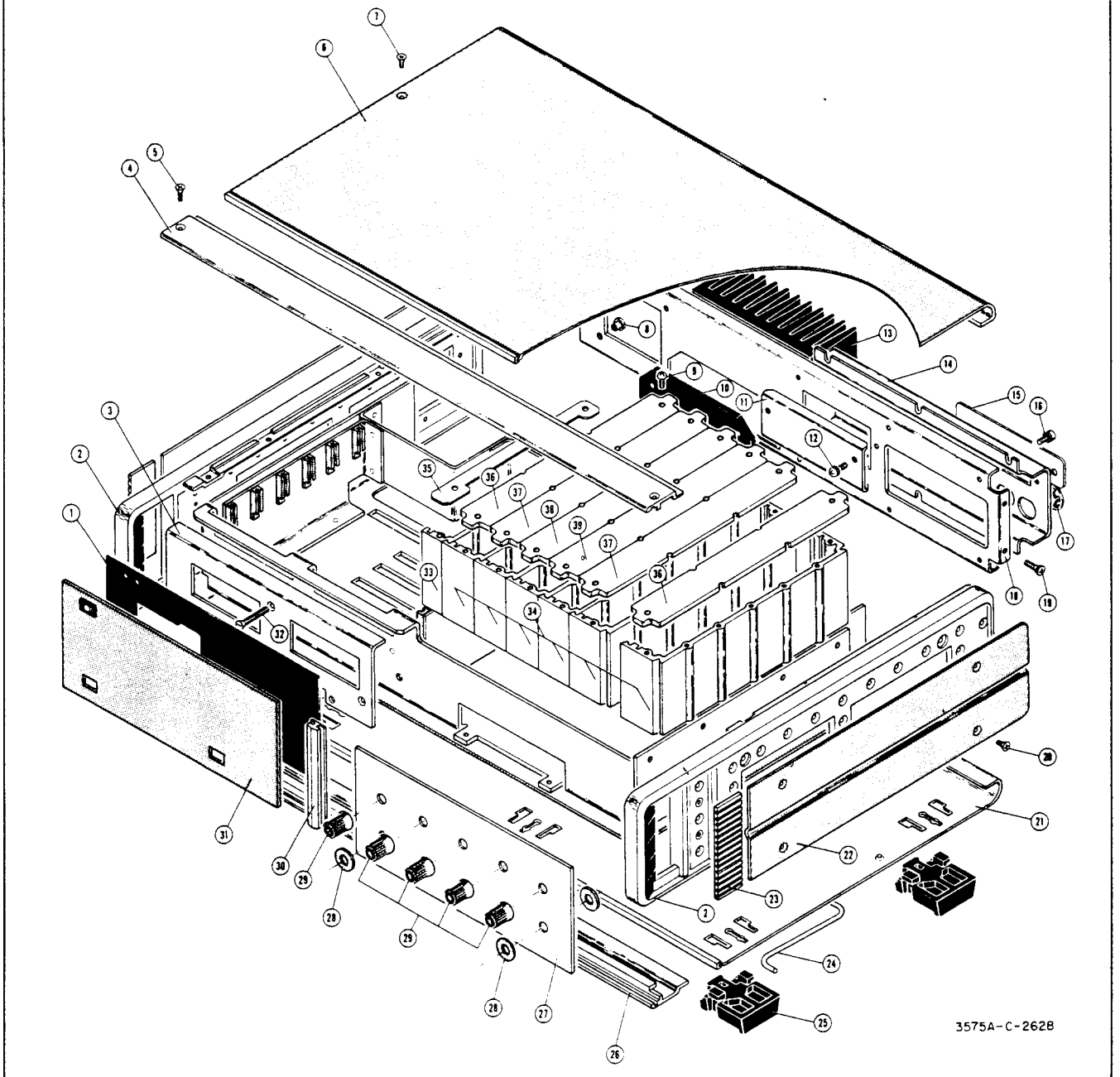



Figure 6-1. Mechanical Parts (Mainframe)

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | CABLES | | |
| W1 | 03575-61601 | 2 | CABLE ASSY: INPUT (INCLUDES J1) | 28480 | 03575-61601 |
| W2 | 03575-61601 | | CABLE ASSY: INPUT (INCLUDES J2) | 28480 | 03575-61601 |
| W3 | 03575-61613 | 2 | CABLE ASSY: PREAMP (INCLUDES P1/J1 AND P2) | 28480 | 03575-61613 |
| W4 | 03575-61613 | | CABLE ASSY: PREAMP (INCLUDES P1/J1 AND P2) | 28480 | 03575-61613 |
| W5 | 03575-61603 | 1 | CABLE ASSY: CHANNEL A (INCLUDES P1 AND P2) | 28480 | 03575-61603 |
| W6 | 03575-61604 | 1 | CABLE ASSY: CHANNEL B (INCLUDES P1 AND P2) | 28480 | 03575-61604 |
| W7 | 03575-61605 | 1 | CABLE ASSY: CURRENT (INCLUDES P1/J1 AND P2) | 28480 | 03575-61605 |
| W8 | 03575-61606 | 2 | CABLE ASSY: (BETWEEN J1 AND CHASSIS) | 28480 | 03575-61606 |
| W9 | 03575-61606 | | CABLE ASSY: (BETWEEN J2 AND CHASSIS) | 28480 | 03575-61606 |
| W10 | 03575-61607 | 1 | CABLE ASSY: POWER SWITCH | 28480 | 03575-61607 |
| W11 | 03575-61608 | 1 | CABLE ASSY: (BETWEEN J5 AND CHASSIS) | 28480 | 03575-61608 |
| W12 | 8120-1378 | 1 | CABLE: POWER | 28480 | 8120-1378 |
| | | | MECHANICAL PARTS (REFER TO FIGURES 6-1 AND 6-2) | | |
| MP1 (STD 3575A) | 7101-0266 | 1 | MASK: DISPLAY | 28480 | 7101-0266 |
| MP1 (OPT 001-003) | 7101-0265 | 1 | MASK: DISPLAY | 28480 | 7101-0265 |
| MP2 | 03575-21201 | 2 | ASSY: FRAME | 28480 | 03575-21201 |
| MP3 | 03575-01212 | 1 | PANEL: DISPLAY | 28480 | 03575-01204 |
| MP4 | 03575-26802 | 1 | TRIM: TOP PANEL | 28480 | 03575-26802 |
| MP5 | 2360-0184 | 4 | SCREW | | |
| MP6 | 03575-04101 | 1 | COVER ASSY: TOP | 28480 | 03575-04101 |
| MP7 | 2360-0196 | | SCREW | | |
| MP8 | 0390-0006 | 4 | BUSHING (FOR T1) | | |
| MP9 | 2200-0766 | 59 | SCREW: MACH | | |
| MP10 | 03575-01207 | 1 | BRACKET: TSTR MTNG | 28480 | 03575-01207 |
| MP11 | 03575-04104 | 1 | COVER: AC TERMINAL | 28480 | 03575-04101 |
| MP12 | 2200-0766 | | SCREW: MACH | | |
| MP13 | 03575-21101 | 1 | HEAT SINK: POWER SUPPLY | 28480 | 03575-21101 |
| MP14 | 03575-00203 | 1 | PANEL: CONNECTOR MTNG | 28480 | 03575-00203 |
| MP15 | 03575-04103 | 1 | COVER: INTERFACE CONN | 28480 | 03575-04103 |
| MP16 | 2360-0195 | | SCREW | | |
| | 2190-0198 | | WASHER: LOCK | | |
| MP17 | 6960-0010 | 2 | PLUG: HOLE | | |
| MP18 | 03575-00202 | 1 | PANEL: REAR | 28480 | 03575-00202 |
| MP19 | | | | | |
| RIGHT SIDE | 2510-0050 | | SCREW | | |
| | 03575-24103 | 1 | PLATE: SPACER | 28480 | 03575-24103 |
| LEFT SIDE | 2510-0052 | | SCREW | | |
| | 2510-0190 | 1 | SCREW: INSULATOR | 28480 | 03575-24108 |
| | 03575-24108 | | SPACER: INSULATOR | | |
| | 2190-0343 | | WASHER: INSULATOR | | |
| | 3050-0026 | | WASHER: FLAT | | |
| | 2190-0087 | | WASHER: LOCK | | |
| | 2580-0015 | | NUT | | |
| MP20 | 2360-0192 | | SCREW | | |
| MP21 | 03575-04102 | 1 | COVER ASSY: BOTTOM | 28480 | 03575-04102 |
| MP22 | 5000-8589 | 2 | COVER: SIDE | 28480 | 5000-8589 |
| MP23 | 5000-0050 | 2 | PLATE: FLUTED | 28480 | 5000-0050 |
| MP24 | 1490-0030 | 1 | STAND: TILT | 28480 | 1490-0030 |
| MP25 | 5060-0767 | 5 | ASSY: FOOT | 28480 | 5060-0767 |
| MP26 | 03575-26803 | 1 | TRIM: BOTTOM PANEL | 28480 | 03575-26803 |
| MP27 | 03575-00211 | 1 | PANEL: FRONT | 28480 | 03575-00211 |
| MP28 | 00310-48801 | 4 | WASHER: SHLDR | 28480 | 00310-48801 |
| MP29 | 0370-1099 | 5 | KNOB: POINTER | 28480 | 0370-1099 |
| MP30 | 03575-26801 | 1 | TRIM: CENTER | 28480 | 03575-26801 |
| MP31 (STD 3575A) | 03575-40201 | 1 | WINDOW: DISPLAY | 28480 | 03575-40201 |
| MP31 (OPT 001-003) | 03575-40202 | 1 | WINDOW: DISPLAY | 28480 | 03575-40202 |
| MP32 | 2200-0084 | 4 | SCREW | | |
| MP33 | 03575-25502 | 1 | SHIELD: CARD NEST | 28480 | 03575-25502 |
| MP34 | 03575-25501 | 6 | SHIELD: CARD NEST | 28480 | 03575-25501 |
| MP35 | 03575-01209 | 1 | STRAP: RETAINER | 28480 | 03575-01209 |
| MP36 | 03575-24104 | 2 | COVER: A1/A2 | 28480 | 03575-24104 |
| MP37 | 03575-24105 | 2 | COVER: A3/A4 | 28480 | 03575-24105 |
| MP38 | 03575-24107 | 1 | COVER: A6 | 28480 | 03575-24107 |
| MP39 | 03575-24106 | 1 | COVER: A5 | 28480 | 03575-24106 |



(Ref: Change 2, 3)

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | MISCELLANEOUS PARTS | | |
| | 03575-01211 | 1 | BRACKET INTERFACE BOARD (REINFORCES A16B) | 28480 | 03575-01211 |
| | 1410-1017 | 10 | BUSHING INSULATOR (FOR A15 Q1-Q5 MTNG) | 28480 | 1410-1017 |
| | 5000-5085 | 1 | CLIP POWER MODULE (A18) | 28480 | 5000-5085 |
| | 0510-0075 | 4 | CLIP TINNERMAN (TOP AND BOTTOM COVERS) | 28480 | 0510-0075 |
| | 5040-5932 | 1 | COVER POWER SWITCH | 28480 | 5040-5932 |
| | 0403-0151 | 2 | GUIDE PC BOARD GREY | 28480 | 0403-0151 |
| | 0403-0152 | 3 | GUIDE PC BOARD BLACK | 28480 | 0403-0152 |
| | 0403-0153 | 4 | GUIDE PC BOARD BROWN | 28480 | 0403-0153 |
| | 0403-0154 | 1 | GUIDE PC BOARD RED | 28480 | 0403-0154 |
| | 0403-0156 | 1 | GUIDE PC BOARD YELLOW | 28480 | 0403-0156 |
| | 0403-0160 | 2 | GUIDE PC BOARD WHITE | 28480 | 0403-0160 |
| | 0340-0704 | 2 | INSULATOR (FOR J5) | | |
| | 03575-24101 | 1 | INSULATOR PLATE (BETWEEN CHASSIS AND A17) | 28480 | 03575-24101 |
| | 0340-0770 | 1 | INSULATOR TSTR BRKT (BETWEEN CHASSIS AND A15) | 28480 | 0340-0770 |
| | 0340-0583 | 2 | INSULATOR TSTR (FOR A15 Q3, Q4) MICA | 8G464 | 7403-10-03 |
| | 0340-0838 | 3 | INSULATOR TSTR (FOR A15 Q1, Q2, Q5) | 28480 | 0340-0838 |
| | 03575-84411 | 1 | KIT ACCESSORY, INCLUDES THE FOLLOWING: | 28480 | 03575-84411 |
| | 5060-5987 | 1 | EXTENDER PC 2 X 10-PIN | 28480 | 5060-5987 |
| | 5060-5988 | 1 | EXTENDER PC 2 X 12-PIN | 28480 | 5060-5988 |
| | 5060-5989 | 1 | EXTENDER PC 2 X 22-PIN | 28480 | 5060-5989 |

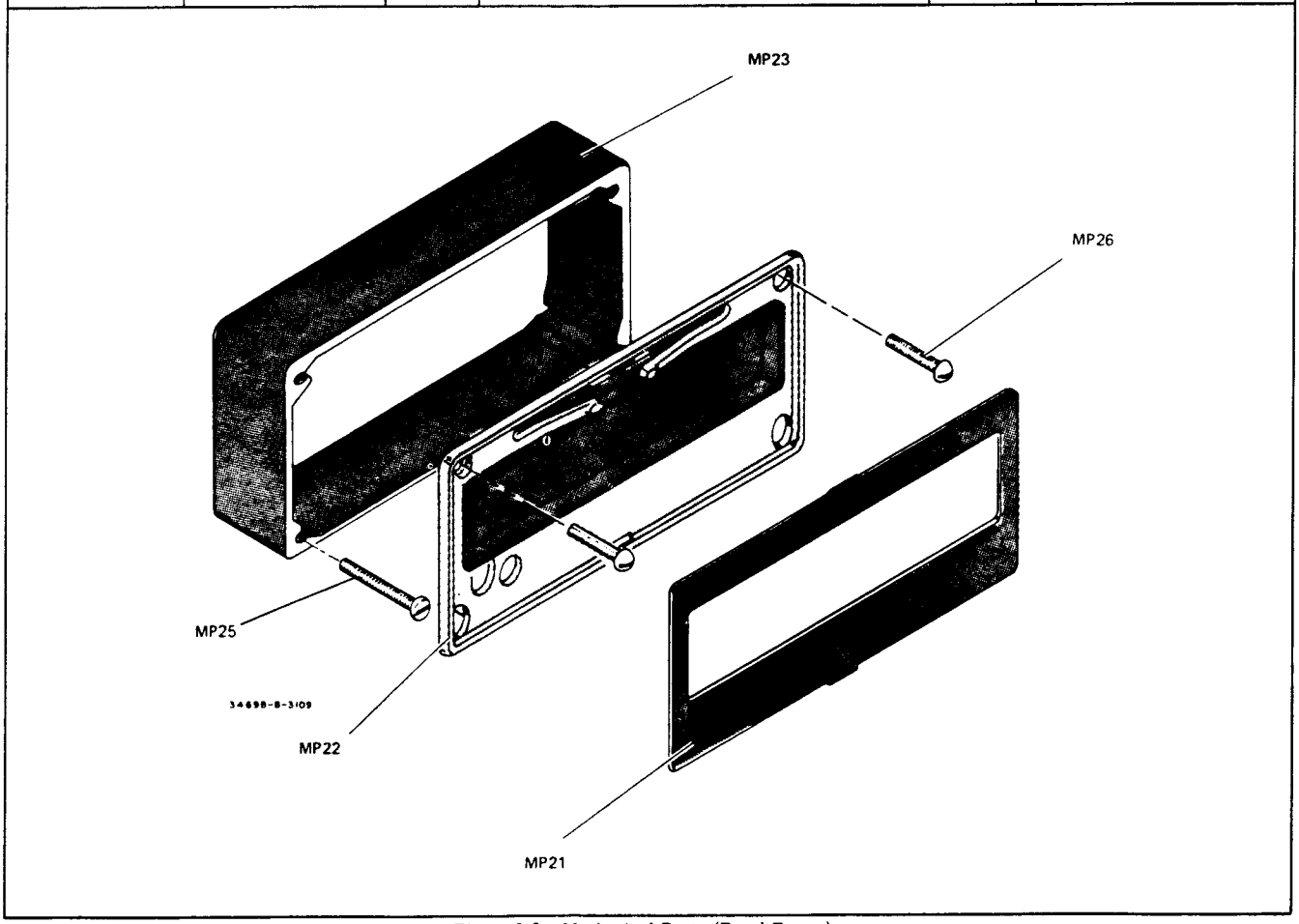



Figure 6-2. Mechanical Parts (Panel Frame).

# SECTION VII
# CIRCUIT DIAGRAMS

## 7-1. INTRODUCTION.

7-2. This section contains a functional block diagram schematic diagrams and component location diagrams for the 3575A Gain-Phase Meter.

## 7-3. FUNCTIONAL BLOCK DIAGRAM.

7-4. The Functional Block Diagram, Figure 7-1, is a detailed block diagram that shows the overall relationship between the major circuit elements in the 3575A. The diagram shows the main signal paths and provides voltages and waveforms that should be beneficial when troubleshooting the instrument.

## 7-5. SCHEMATIC DIAGRAMS.

7-6. The schematic diagrams, Figures 7-2 through 7-11, show the detailed circuits of the standard Model 3575A and Options 001 thru 003. Each schematic is assigned a numerical call out (1 through 10) which is used for interconnection referencing on the schematics and for schematic referencing on the functional block diagram and troubleshooting trees. The schematics are arranged to provide as much signal continuity as possible and assemblies do not necessarily appear in the order of their reference designations. Refer to Table 7-1 for a complete cross reference listing.

## 7-7. Measurement Conditions.

7-8. Voltages and waveforms are provided on the schematics to aid in troubleshooting the instrument. Unless otherwise specified, all voltages and waveforms were obtained with a 2 V rms (+6 dBV), 1 kHz sine wave applied to both inputs (inputs in phase) and the 3575A controls set as follows:

Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE .....+ A

## 7-9. Notes.

7-10. Refer to the General Schematic Notes (Page 7-2) for further information concerning the schematic diagrams.

**Table 7-1. Assembly Cross Reference.**

| Assembly Number | Assembly Title | Assembly Part Number | Schematic Number | Figure Number |
|---|---|---|---|---|
| A1 | Preamplifier Assembly | 03575-66501 | 1 | 7-2 |
| A2 | Preamplifier Assembly | 03575-66501 | 1 | 7-2 |
| A3 | Log Converter Assembly | 03575-66503 | 1 | 7-2 |
| A4 | Log Converter Assembly | 03575-66503 | 1 | 7-2 |
| A5 | Phase Detector Assembly | 03575-66505 | 2 | 7-3 |
| A6 | Current Source Assembly | 03575-66506 | 3 | 7-4 |
| A7 | Phase Control Filter Assembly | 03575-66507 | 4 | 7-5 |
| A8 | Function Switching Assembly | 03575-66508 | 5 | 7-6 |
| A9 | Output Filter Assembly | 03575-66509 | 6 | 7-7 |
| A10* | Output Filter Assembly | 03575-66509 | 6 | 7-7 |
| A11 | Phase Control Logic Assembly | 03575-66511 | 3 | 7-4 |
| A12A | Panel Meter Connector Assembly | 03575-66550 | 10 | 7-11 |
| A12B* | Panel Meter Connector Assembly | 03575-66551 | 10 | 7-11 |
| A13 | Front Panel Switching Assembly | 03575-66513 | 5 | 7-6 |
| A14 | Power Supply Assembly | 03575-66514 | 8 | 7-9 |
| A15 | Power Supply Mother Board Assembly | 03575-66515 | 8 | 7-9 |
| A16A | Interface Substitution Assembly | 03575-26516 | 5 | 7-6 |
| A16B** | Interface Assembly Negative | 03575-66552 | 9 | 7-10 |
| A16C† | Interface Assembly Positive | 03575-66553 | 9 | 7-10 |
| A17 | Mother Board Assembly | 03575-66517 | | |
| A18 | Power Input Module | 5060-1200 | 8 | 7-9 |
| A19**† | Interface Connector Assembly | 03575-66519 | 9 | 7-10 |
| A20,21,22 | Digital Panel Meter (std & opt 001) | 5060-9188 | 7 | 7-8 |
| A20,21,22 | Digital Panel Meter (opt 002 & 003) | 5060-9127 | 7 | 7-8 |

*Option 001–003 **Option 002 †Option 003

# GENERAL SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
   INDUCTANCE IN MILLIHENRYS

3. DENOTES EARTH GROUND. USED FOR TERMINALS WITH NO LESS THAN A NO. 18 GAUGE WIRE CONNECTED BETWEEN TERMINAL AND EARTH GROUND TERMINAL OR AC POWER RECEPTACLE.

4. DENOTES FRAME GROUND. USED FOR TERMINALS WHICH ARE PERMANENTLY CONNECTED WITHIN APPROXIMATELY 0.1 OHM OF EARTH GROUND.

5. DENOTES GROUND ON PRINTED CIRCUIT ASSEMBLY. (PERMANENTLY CONNECTED TO FRAME GROUND).

6. DENOTES ASSEMBLY.

7. DENOTES MAIN SIGNAL PATH.

9. DENOTES FEEDBACK PATH.

10. DENOTES FRONT PANEL MARKING.

11. DENOTES REAR PANEL MARKING.

12. DENOTES SCREWDRIVER ADJUST.

13. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY. THE VALUE OF THESE COMPONENTS MAY VARY FROM ONE INSTRUMENT TO ANOTHER. THE METHOD OF SELECTING THESE COMPONENTS IS DESCRIBED IN SECTION V OF THIS MANUAL.

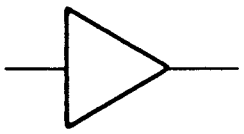
14. DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.

15. \924/ DENOTES WIRE COLOR: COLOR CODE SAME AS RESISTOR COLOR CODE. FIRST NUMBER IDENTIFIES BASE COLOR, SECOND NUMBER IDENTIFIES WIDER STRIP, THIRD NUMBER IDENTIFIES NARROWER STRIP. (e.g. \924/ = WHITE, RED, YELLOW.)

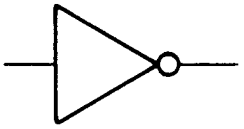
17. ALL RELAYS ARE SHOWN DEENERGIZED.

18. WAVEFORMS AND AC VOLTAGE MEASUREMENTS WERE MADE WITH RESPECT TO CHASSIS GROUND USING AN OSCILLOSCOPE WITH A 10:1 DIVIDER PROBE (10 MEGOHM, 10 pF). THE VOLTAGE LEVELS SHOWN ON THE WAVEFORMS ARE ACTUAL VOLTAGE LEVELS AND ARE NOT TO BE CONFUSED WITH OSCILLOSCOPE SETTING. THE VOLTAGE LEVELS SHOWN ARE NOMINAL AND MAY VARY FROM ONE INSTRUMENT TO ANOTHER. A VARIATION OF ± 10 % IN MEASUREMENTS SHOULD BE ALLOWED.

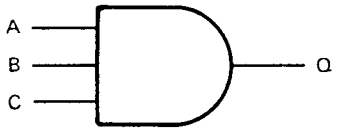
19. DC VOLTAGE LEVELS WERE MEASURED WITH RESPECT TO CIRCUIT GROUND USING A VTVM WITH 10 MEGOHM INPUT IMPEDANCE. THE VOLTAGE LEVELS SHOWN ARE NOMINAL AND MAY VARY FROM ONE INSTRUMENT TO ANOTHER DUE TO CHANGE IN TRANSISTOR CHARACTERISTICS. A VARIATION OF ± 10 % SHOULD BE ALLOWED.



DENOTES BUFFER

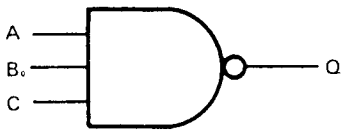


DENOTES INVERTER



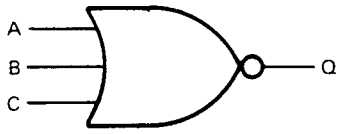

DENOTES AND GATE

| A | B | C | Q |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 |



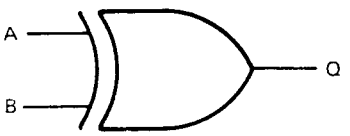

DENOTES NAND GATE

| A | B | C | Q |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |




DENOTES NOR GATE

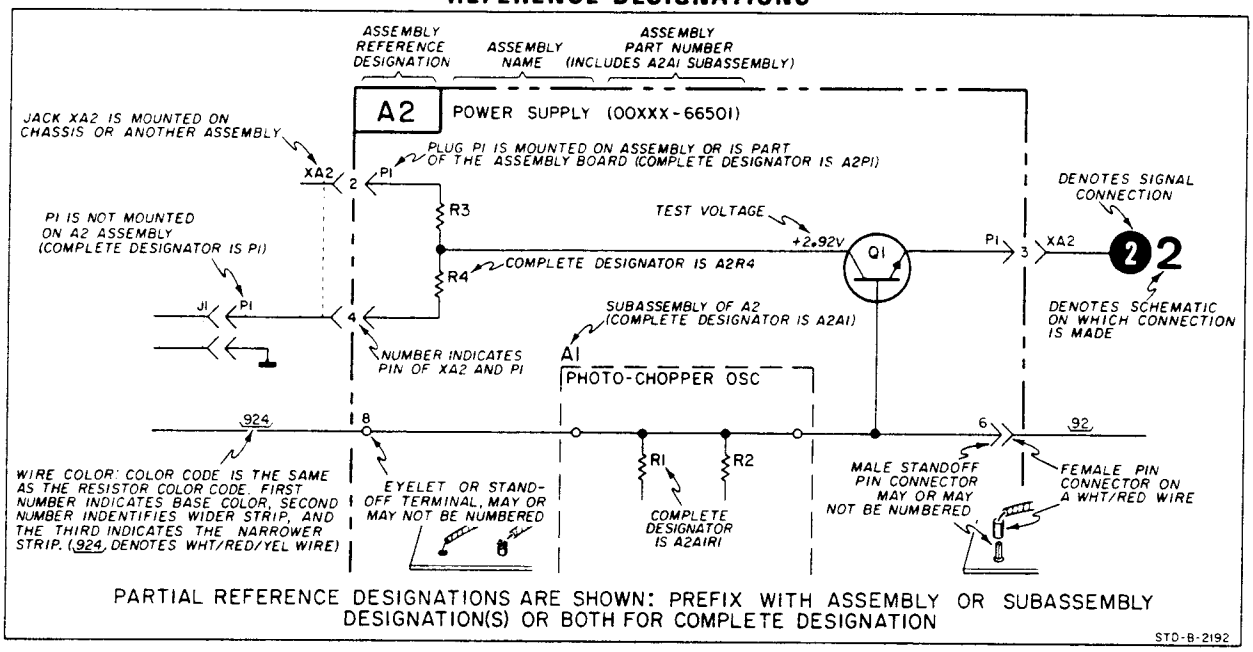
| A | B | C | Q |
|---|---|---|---|
| 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 0 |




DENOTES EXCLUSIVE OR GATE

| A | B | Q |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

## REFERENCE DESIGNATIONS


ASSEMBLY REFERENCE DESIGNATION
ASSEMBLY NAME
ASSEMBLY PART NUMBER (INCLUDES A2A1 SUBASSEMBLY)
A2
POWER SUPPLY (00XXX-66501)
JACK XA2 IS MOUNTED ON CHASSIS OR ANOTHER ASSEMBLY
XA2
PLUG P1 IS MOUNTED ON ASSEMBLY OR IS PART OF THE ASSEMBLY BOARD (COMPLETE DESIGNATOR IS A2P1)
P1 IS NOT MOUNTED ON A2 ASSEMBLY (COMPLETE DESIGNATOR IS P1)
J1
P1
R3
R4
TEST VOLTAGE
+2.92V
Q1
COMPLETE DESIGNATOR IS A2R4
SUBASSEMBLY OF A2 (COMPLETE DESIGNATOR IS A2A1)
A1
PHOTO-CHOPPER OSC
NUMBER INDICATES PIN OF XA2 AND P1
DENOTES SIGNAL CONNECTION
DENOTES SCHEMATIC ON WHICH CONNECTION IS MADE
924
92
WIRE COLOR: COLOR CODE IS THE SAME AS THE RESISTOR COLOR CODE. FIRST NUMBER INDICATES BASE COLOR, SECOND NUMBER INDENTIFIES WIDER STRIP, AND THE THIRD INDICATES THE NARROWER STRIP. (924 DENOTES WHT/RED/YEL WIRE)
EYELET OR STAND-OFF TERMINAL, MAY OR MAY NOT BE NUMBERED
R1
R2
COMPLETE DESIGNATOR IS A2A1R1
MALE STANDOFF PIN CONNECTOR MAY OR MAY NOT BE NUMBERED
FEMALE PIN CONNECTOR ON A WHT/RED WIRE

PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION

STD-B-2192

| Pin No. | Connection |
|---|---|
| XA1 - 1 | GND |
| 2 | GND |
| 3 | GND |
| 4 | GND |
| 5 | XA3-4, XA7-2, XA5-5, XA4-9 |
| 6 | XA7-6, XA6-7 |
| 7 | XA8-W, XA16-18 |
| 8 | NC |
| 9 | XA7-3 |
| 10 | XA3-10, XA14-4 |
| 11 | XA3-11, XA14-7, XA7-4 |
| 12 | XA3-12, XA7-12-NC, XA14-8 |
| 13 | XA3-13, XA14-9 |
| 14 | XA3-14, XA14-10 |
| 15 | GND |
| 16 | GND |
| 17 | GND |
| 18 | XA3-18, XA6-18, XA5-18, XA4-18, XA2-18, XA7-20, XA16-S |
| 19 | XA3-19, XA6-19, XA5-19, XA4-19, XA2-19, XA7-21, XA16-14 |
| 20 | XA16-13, XA4-8, XA5-3, XA6-3 XA8-X, XA12-D |
| 21 | NC |
| 22 | NC |
| XA2 - 1 | GND |
| 2 | GND |
| 3 | GND |
| 4 | GND |
| 5 | NC |
| 6 | NC |
| 7 | XA16-V, XA4-3, XA8-18 |
| 8 | XA12-Y, XA2-22, XA16-17 |
| 9 | XA5-2, XA6-2, XA3-3, XA7-A |
| 10 | XA4-10, XA14-4 |
| 11 | XA4-11, XA14-6, XA7-D |
| 12 | NC |
| 13 | XA4-13, XA14-9 |
| 14 | XA4-14, XA5-20, XA14-10 |
| 15 | GND |
| 16 | GND |
| 17 | GND |
| 18 | XA4-18, XA5-18, XA6-18, XA3-18 XA1-18, XA7-20, XA16-S |
| 19 | XA4-19, XA5-19, XA6-19, XA3-19 XA1-19, XA7-21, XA16-14 |
| 20 | XA4-4, XA8-19-2, XA12-F, XA16-R |
| 21 | NC |
| 22 | XA2-8, XA12-Y, XA16-17 |
| XA3 - 1 | GND |
| 2 | GND |
| 3 | XA7-A, XA5-2, XA6-2, XA2-9 |
| 4 | XA1-5, XA7-2, XA5-5, XA4-9 |
| 5 | NC |
| 6 | XA8-21 |
| 7 | XA8-22 |
| 8 | XA7-8-J, XA11-21, XA6-9 |
| 9 | XA7-1 |
| 10 | XA1-10, XA14-4 |
| 11 | XA1-11, XA14-7, XA7-4 |
| 12 | XA1-12, XA7-12-NC, XA14-8 |
| 13 | XA1-13, XA14-9 |
| 14 | XA1-14, XA14-10 |
| 15 | GND |
| 16 | GND |
| 17 | GND |
| 18 | XA1-18, XA6-18, XA5-18, XA4-18, XA2-18, XA7-20, XA16-S |
| 19 | XA1-19, XA6-19, XA5-19, XA4-19, XA2-19, XA7-21, XA16-14 |
| 20 | NC |
| 21 | NC |
| 22 | XA7-22 |
| XA4 - 1 | GND |
| 2 | GND |
| 3 | XA2-7, XA16-V, XA8-18 |
| 4 | XA2-20, XA8-19-A, XA12-F, XA16-9 |
| 5 | NC |
| 6 | XA8-20 |
| 7 | XA8-Y |
| 8 | XA16-13, XA5-3, XA6-3, XA8-X-1 |
| 9 | XA5-5, XA3-4, XA1-5, XA7-2 XA12-D |
| 10 | XA2-10, XA14-4 |
| 11 | XA2-11, XA7-D, XA14-6 |
| 12 | XA14-8 |
| 13 | XA2-13, XA14-9 |
| 14 | XA2-14, XA5-20, XA14-10 |
| 15 | GND |
| 16 | GND |
| 17 | GND |
| 18 | XA2-18, XA5-18, XA6-18, XA3-18, XA1-18, XA7-20, XA16-S |
| 19 | XA2-19, XA5-19, XA6-19, XA3-19 XA1-19, XA7-21, XA16-14 |
| 20 | NC |
| 21 | XA8-9-K, XA5-21, XA16-T |
| 22 | XA7-Z |
| XA5 - 1 | GND |
| 2 | XA6-2, XA2-9, XA3-3, XA7-A |
| 3 | XA6-3, XA4-8, XA16-13, XA8-X-1, XA12-D |
| 4 | XA6-4, XA8-V |
| 5 | XA4-9, XA3-4, XA1-5, XA7-2 |
| 6 | XA6-5 |
| 7 | XA6-6 |
| 8 | NC |
| 9 | XA11-22 |
| 10 | XA6-10, XA11-14, XA14-4, XA7-10-L |

| Pin No. | Connection |
|---|---|
| | 11 XA6-11, XA13-4, XA14-5, XA11-10, XA10-10, XA9-10 |
| | 12 XA6-12 |
| | 13 XA6-13, XA7-13-P, XA14-9 |
| | 14 XA6-14, XA7-14-R, XA14-10 |
| | 15 GND |
| | 16 GND |
| | 17 GND |
| | 18 XA1-18, XA3-18, XA6-18, XA4-18, XA2-18, XA7-20, XA16-S |
| | 19 XA1-19, XA3-19, XA6-19, XA4-19, XA2-19, XA7-21, XA16-14 |
| | 20 XA4-14, XA2-14, XA14-10 |
| | 21 XA4-21, XA8-9-K, XA16-T |
| | 22 XA16-U |
| XA6 - | 1 GND |
| | 2 XA5-2, XA2-9, XA3-3, XA7-A |
| | 3 XA5-3, XA4-8, XA16-13, XA8-X-1 XA12-D |
| | 4 XA5-4, XA8-V |
| | 5 XA5-6 |
| | 6 XA5-7 |
| | 7 XA1-6, XA7-6 |
| | 8 XA11-20 |
| | 9 XA3-8, XA7-8-J, XA11-21 |
| | 10 XA5-10, XA11-14, XA14-4 |
| | 11 XA5-11, XA13-4, XA14-5, XA11-10 XA10-10, XA9-10 |
| | 12 XA5-12 |
| | 13 XA5-13, XA7-13-P, XA14-9 |
| | 14 XA5-14, XA7-14-R, XA14-10 |
| | 15 GND |
| | 16 GND |
| | 17 GND |
| | 18 XA1-18, XA3-18, XA5-18, XA4-18, XA2-18, XA7-20, XA16-S |
| | 19 XA1-19, XA3-19, XA5-19, XA4-19, XA2-19, XA7-21, XA16-14 |
| | 20 NC |
| | 21 NC |
| | 22 NC |
| XA7 - | 1 XA3-9 |
| | 2 XA1-5, XA3-4, XA5-5, XA4-9 |
| | 3 XA1-9 |
| | 4 XA1-11, XA3-11, XA14-7 |
| | 5 NC |
| | 6 XA1-6, XA6-7 |
| | 7 NC |
| | 8 XA3-8, XA11-21, XA6-9, XA7-J |
| | 9 NC |
| | 10 XA7-L, XA5-10, XA11-14, XA14-4 |
| | 11 XA7-M, XA14-5 |
| | 12 XA7-N, XA1-12, XA3-12, XA14-8 |
| | 13 XA7-P XA5-13, XA6-13, XA14-9 |
| | 14 XA7-R, XA5-14, XA6-14, XA14-10 |
| | 15 GND |
| | 16 GND |
| | 17 GND |
| | 18 NC |
| | 19 NC |
| | 20 XA1-18, XA3-18, XA6-18, XA5-18, XA4-18, XA1-18, XA16-S |
| | 21 XA1-19, XA3-19, XA6-19, XA5-19, XA4-19, XA2-19, XA16-14 |
| | 22 XA3-22 |

| Pin No. | Connection |
|---|---|
| XA7 -A | XA3-3, XA5-2, XA6-2, XA2-9 |
| B | XA8-Z |
| C | XA7-N-12, XA1-12, XA3-12, XA14-8 |
| D | XA14-6, XA2-11, XA4-11 |
| E | XA11-17 |
| F | XA11-18 |
| H | XA11-19 |
| J | XA7-8, XA3-8, XA11-21, XA6-9 |
| K | NC |
| L | XA7-10, XA5-10, XA11-14, XA14-4 |
| M | XA7-11, XA14-5 |
| N | XA7-12, XA1-12, XA3-12, XA14-8 |
| P | XA7-13, XA5-13, XA6-13, XA14-9 |
| R | XA7-14, XA5-14, XA6-14, XA14-10 |
| S | GND |
| T | GND |
| U | GND |
| V | XA10-22, XA9-22 |
| W | XA10-21, XA9-21 |
| X | XA10-20, XA9-20 |
| Y | NC |
| Z | XA4-22 |
| XA8 - 1 | XA12-D, XA8-X, XA16-13, XA5-3, XA4-8, XA6-3 |
| 2 | XA12-E |
| 3 | XA12-H |
| 4 | NC |
| 5 | XA12-L |
| 6 | NC |
| 7 | XA8-H, XA12-12-N-19-W, XA9-6, XA10-5, XA11-8, XA14-1-2 |
| 8 | XA8-J, XA16-15 |
| 9 | XA8-K, XA4-21, XA5-21, XA16-T |
| 10 | XA8-L, XA16-16 |
| 11 | XA8-M, XA12-R, XA9-8, XA10-8 XA14-8 |
| 12 | XA8-N, XA9-9, XA10-9, XA11-9, XA14-4 |
| 13 | XA8-P, XA12-T, XA9-10, XA10-10, XA11-10, XA14-5 |
| 14 | XA8-R, XA12-U, XA9-11, XA10-11, XA11-11, XA14-9 |
| 15 | XA8-S, XA12-V, XA9-12, XA10-12, XA11-12, XA14-10 |
| 16 | XA8-T, XA9-13, XA10-13, XA11-13, XA14-1-2 |
| 17 | XA10-18 |
| 18 | XA4-3, XA2-7, XA16-V |
| 19 | XA4-4, XA2-20, XA8-A, XA12-F, XA16-9 |
| 20 | XA4-6 |
| 21 | XA3-6 |
| 22 | XA3-7 |
| XA8 -A | XA8-19, XA4-4, XA2-20, XA12-F, XA16-P |
| B | XA12-10, XA16-P |
| C | XA12-J |
| D | XA12-K |
| E | XA12-11 |
| F | NC |
| H | XA8-7, XA12-12-N-19-W, XA9-6, XA6-5, XA11-8, XA14-12 |
| J | XA8-8, XA16-15 |
| K | XA8-9, XA4-21, XA5-21, XA16-T |

| Pin No. | Connection |
|---|---|
| L | XA8-10, XA16-16 |
| M | XA8-11, XA12-R, XA9-8, XA10-8, XA14-8 |
| N | XA8-N, XA9-9, XA10-9, XA11-9, XA14-4 |
| P | XA8-13, XA12-9, XA9-10, XA10-10, XA11-10, XA14-5 |
| R | XA8-14, XA12-U, XA9-11, XA10-11, XA11-11, XA14-9 |
| S | XA8-15, XA12-V, XA9-12, XA10-12, XA11-12, XA14-10 |
| T | XA8-16, XA9-13, XA10-13 XA11-13, XA14-1-2 |
| U | XA9-18 |
| V | XA6-4, XA5-4 |
| W | NC |
| X | NC |
| Y | XA4-7 |
| Z | XA7-B |
| XA9 - 1 | XA10-15 Analog Output 1 |
| 2 | NC |
| 3 | NC |
| 4 | NC |
| 5 | XA9-7, XA12-M, XA10-6, XA11-6 |
| 6 | XA8-H-7, XA12-12-N-19-W, XA10-5 |
| 7 | XA9-5, XA12-M, XA10-6, XA11-6 |
| 8 | XA8-11-M, XA12-R, XA10-8, XA14-8 |
| 9 | XA8-12-N, XA10-9, XA11-9, XA14-4 |
| 10 | XA8-13-P, XA12-T, XA10-10, XA11-10, XA14-5 |
| 11 | XA8-14-R, XA12-U, XA10-11, XA11-11, XA14-9 |
| 12 | XA8-15-S, XA12-V, XA10-12, XA11-12, XA14-10 |
| 13 | XA8-16-T, XA10-13, XA11-13, XA14-1-2 |
| 14 | XA9-13 |
| 15 | NC |
| 17 | NC |
| 17 | NC |
| 18 | XA8-U |
| 19 | NC |
| 20 | XA10-20, XA7-X |
| 21 | XA10-21, XA7-W |
| 22 | XA10-22, XA7-V |
| XA10- 1 | Analog Output No. 2 |
| 2 | NC |
| 3 | NC |
| 4 | NC |
| 5 | XA9-6, XA8-H-7, XA12-12-N-19-W |
| 6 | XA9-5-7, XA12-M, XA11-6 |
| 7 | XA12-P, XA11-7 |
| 8 | XA9-8, XA8-11-M, XA12-R, XA14-8 |
| 9 | XA9-9, XA8-12-N, XA11-9, XA14-4 |
| 10 | XA8-13-P, XA12-T, XA9-10, XA11-10, XA14-5 |
| 11 | XA8-14-R, XA12-U, XA9-11 XA11-11, XA14-9 |
| 12 | XA8-15-S, XA12-V, XA9-12, XA11-12, XA14-10 |
| 13 | XA8-16-T, XA9-13, XA11-13, XA14-1-2 |

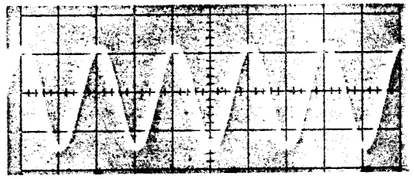
| Pin No. | Connection |
|---|---|
| 14 | XA10-13 |
| 15 | XA9-1, Analog Output No. 1 |
| 16 | XA16-N, XA12-C |
| 17 | NC |
| 18 | XA8-17 |
| 19 | NC |
| 20 | XA9-20, XA7-X |
| 21 | XA9-21, XA7-W |
| 22 | XA9-22, XA7-V |
| XA11- 1 | NC |
| 2 | NC |
| 3 | NC |
| 4 | NC |
| 5 | NC |
| 6 | XA10-6, XA9-5-7, XA12-M |
| 7 | XA10-7, XA12-P |
| 8 | XA10-5, XA9-6, XA8-H-7, XA12-12-N-19-W |
| 9 | XA10-9, XA9-9, XA8-12-N, XA14-4 |
| 10 | XA10-10, XA8-13-P, XA12-T, XA9-10, XA14-5 |
| 11 | XA10-11, XA8-14-R, XA12-U, XA9-11, XA14-9 |
| 12 | XA10-12, XA8-15-S, XA12-V, XA9-12, XA14-10 |
| 13 | XA10-13, XA8-16-T, XA9-13, XA14-1-2 |
| 14 | XA14-4, XA5-10, XA6-10, XA7-10-L |
| 15 | NC |
| 16 | NC |
| 17 | XA7-E |
| 18 | XA7-F |
| 19 | XA7-H |
| 20 | XA6-8 |
| 21 | XA7-8-J, XA3-8, XA6-9 |
| 22 | XA5-9 |
| XA12- 1 | XA16-J |
| 2 | XA16-H |
| 3 | XA16-F |
| 4 | XA16-E |
| 5 | XA16-D |
| 6 | XA16-C |
| 7 | XA16-B |
| 8 | XA16-A |
| 9 | XA9-14 |
| 10 | XA8-B, XA16-P |
| 11 | XA8-E |
| 12 | XA8-7-H, XA12-N-19-W, XA9-6 |
| 13 | XA16-9 |
| 14 | XA16-8 |
| 15 | XA16-7 |
| 16 | XA16-6 |
| 17 | XA16-5 |
| 18 | XA16-4 |
| 19 | XA12-W-N-12, XA8-7-H, XA9-6 |
| 20 | XA16-3 |
| 21 | XA16-2 |
| 22 | XA16-1 |
| XA12-A | XA16-12 |
| B | XA16-K |
| C | XA10-16, XA16-N |

| Pin No. | Connection |
|---|---|
| D | XA8-1-X, XA16-13 |
| E | XA8-2 |
| F | XA8-A |
| H | XA8-3 |
| J | XA8-C |
| K | XA8-D |
| L | XA8-5 |
| M | XA9-5 |
| N | XA12-W-12-19, XA8-7-H, XA9-6 |
| P | XA10-7, XA11-7 |
| R | XA8-11-M, XA9-8, XA10-8, XA14-8 |
| S | XA14-4, XA16-10-L |
| T | XA8-13-P, XA9-10, XA10-10, XA11-10, XA14-5 |
| U | XA8-14-R, XA9-11, XA10-11, XA11-11, XA14-9 |
| V | XA8-15-S, XA9-12, XA10-12, XA11-12, XA14-10 |
| W | XA12-N-12-19, XA8-7-H, XA9-6 |
| X | A10-14-13 |
| Y | XA2-8-22, XA16-17 |
| Z | NC |
| XA13- 1 | XA12-S, XA14-4, XA16-10-L |
| 2 | GND |
| 3 | NC |
| 4 | XA5-11, XA6-11, XA14-5, XA11-10 XA10-10, XA9-10 |
| 5 | NC |
| 6 | XA16-19 |
| 7 | XA16-W |
| 8 | XA16-20 |
| 9 | NC |
| 10 | XA16-X |
| 11 | XA16-21 |
| 12 | NC |
| 13 | NC |
| 14 | XA16-22 |
| 15 | XA16-Y |
| XA14- 1 | GND |
| 2 | GND |
| 3 | NC |
| 4 | XA1-XA7-10, XA8-12, XA9-XA11-9 XA12-S, XA13-1, XA16-L-10 |
| 5 | XA7-11-M, XA11-10, XA10-10, XA9-10 XA8-12-N, XA12-R, XA5-11, XA6-11 XA13-4 |
| 6 | XA2-11, XA4-11, XA7-D |
| 7 | XA1-11, XA3-11, XA7-4 |
| 8 | XA1-12, XA3-12, XA4-12, XA7-12-N |
| 9 | XA1-XA7-13, XA8-14, XA9-XA11-11, XA12-U |
| 10 | XA1-XA7-14, XA8-15, XA9-XA11-12 |
| 11 | GND |
| 12 | GND |
| XA16- 1 | XA12-22 |
| 2 | XA12-21 |
| 3 | XA12-20 |
| 4 | XA12-18 |
| 5 | XA12-17 |
| 6 | XA12-16 |
| 7 | XA12-15 |

| Pin No. | Connection |
|---|---|
| 8 | XA12-14 |
| 9 | XA12-13 |
| 10 | XA16-L, XA14-4 |
| 11 | GND |
| 12 | XA12-A |
| 13 | XA12-D, XA8-1-X |
| 14 | XA7-21, XA1-XA6-19 |
| 15 | XA8-8-J |
| 16 | XA8-10-L |
| 17 | XA12-Y, XA2-8-22 |
| 18 | XA1-7, XA8-W |
| 19 | XA13-6 |
| 20 | XA13-8 |
| 21 | XA13-11 |
| 22 | XA13-14 |
| XA16-A | XA12-8 |
| B | XA12-7 |
| C | XA12-6 |
| D | XA12-5 |
| E | XA12-4 |
| F | XA12-3 |
| H | XA12-2 |
| J | XA12-1 |
| K | XA12-B |
| L | XA16-10, XA14-4 |
| M | GND |
| N | XA12-C, XA10-16 |
| P | XA8-B, XA12-10 |
| R | XA2-20, XA4-4, XA8-19-2, XA12-F |
| S | XA7-20, XA1-XA6-18 |
| T | XA8-9-K, XA4-21, XA5-21 |
| U | XA5-22 |
| V | XA8-18, XA4-3, XA2-7 |
| W | XA13-7 |
| X | XA13-10 |
| Y | XA13-15 |
| Z | NC |

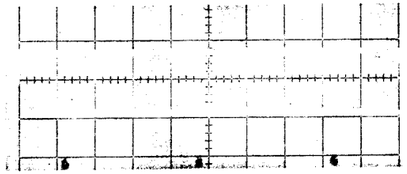
Table 7-2. Mother Board Pin Connections.

1



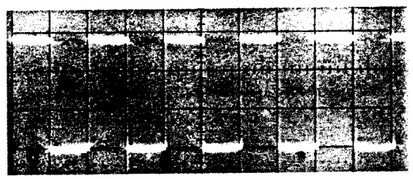
.5 ms/cm, 2 V/cm (10 X .2 V range)

2



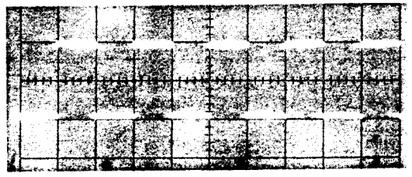
.5 ms/cm, .5 V/cm (10 X .05 V range)

3



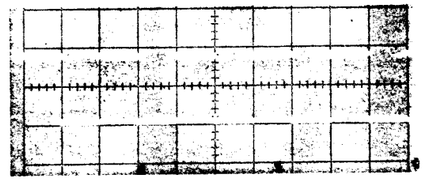
.5 ms/cm, .2 V/cm (10 X .02 V range)

4



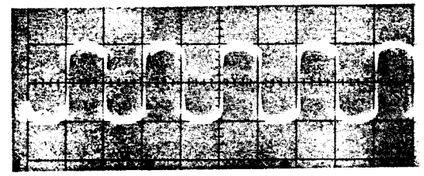
.5 ms/cm, 1 V/cm (10 X .1 V range)

5



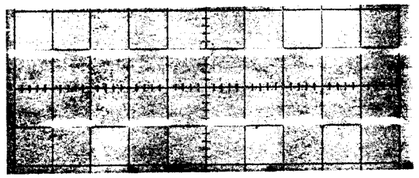
.5 ms/cm, 1 V/cm (10 X .1 V range)

8



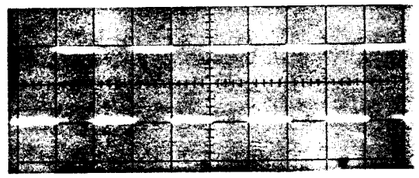
.5 ms/cm, .5 V cm (10 X .05 range)

9



.5 ms/cm, .5 V/cm (10 X .05 range)

10



.5 ms/cm, .5 V/cm (10 X .05 range)

CHANNEL A

A1 1

INPUT ATTENUATOR

CHANNEL A
1MΩ 30pF

J1 W1 J1

C1

ATTENUATOR ADJ

C2

P/O K1

R5 900K

R6 100K

P/O K2

PHASE ADJ

R4

R38

C27

PREAMP Q3-Q7

J2

OVERLOAD DETECTOR Q8-Q10

-FDBK

R39

R22

L1

C4

INTEGRATOR IC1

-DC FEEDBACK

DC FEEDBACK

C5 0.1

A22 7

+3.8V

Q16

AOL

DS8

PM DISPLAY

W3

J1

LIMITER CR1-CR4

0.8V P-P MAX

A3 1

LOG AMPLIFIER IC1

LIMIT AMPLIFIER IC4A

DIFF. AMPLIFIER IC4B

LOG

SYNC RECT. IC5

C17

C18

IC6 SUMMING AMP

LIMITED

NOISE FILTER Q4-Q6

FR1 FR2

FILTER IC2

LEVEL TRANS Q8-Q9

PHASE REFERENCE

+5V -A A

LOG A

-740 mVdc TO +60 mVdc

A5 2

+5V

R44

Q1

R1 +5V

R2 -5.3V

LIMITER

R3

R6

IC1A

A CHANNEL EXCL OR

B CHANNEL EXCL OR

IC2C

IC2D

IC3A

IC3B

FLIP FLOP IC7A

FLIP FLOP IC7B

ERROR CORRECTION IC4-IC6

DIFF AMPLIFIER IC8B

DIFF AMPLIFIER IC8A

W5

NOTE:
CHANNELS A AND B ARE IDENTICAL. CHANNEL B IS SHOWN IN SIMPLIFIED BLOCK FORMAT.

CHANNEL B

A2 1

VOLTAGE RANGE

INPUT ATTENUATOR

CHANNEL B
1MΩ 30pF

J2 W2 J1

C1

PREAMP

OVERLOAD DETECTOR

A22 7

+3.8V

Q17

BOL

DS9

W4

J1

A4 1

FREQUENCY RANGE

LOG AMPLIFIER

LIMITED

NOISE FILTER

LEVEL TRANS

SYNC RECT

SUMMING AMP

LOG

LOG B

-740 mVdc TO +60 mVdc

W6

J3

R9

IC1C

R12

A6 3

DIFF. AMPLIFIER IC1B

$V_{BE}$ -1.1V

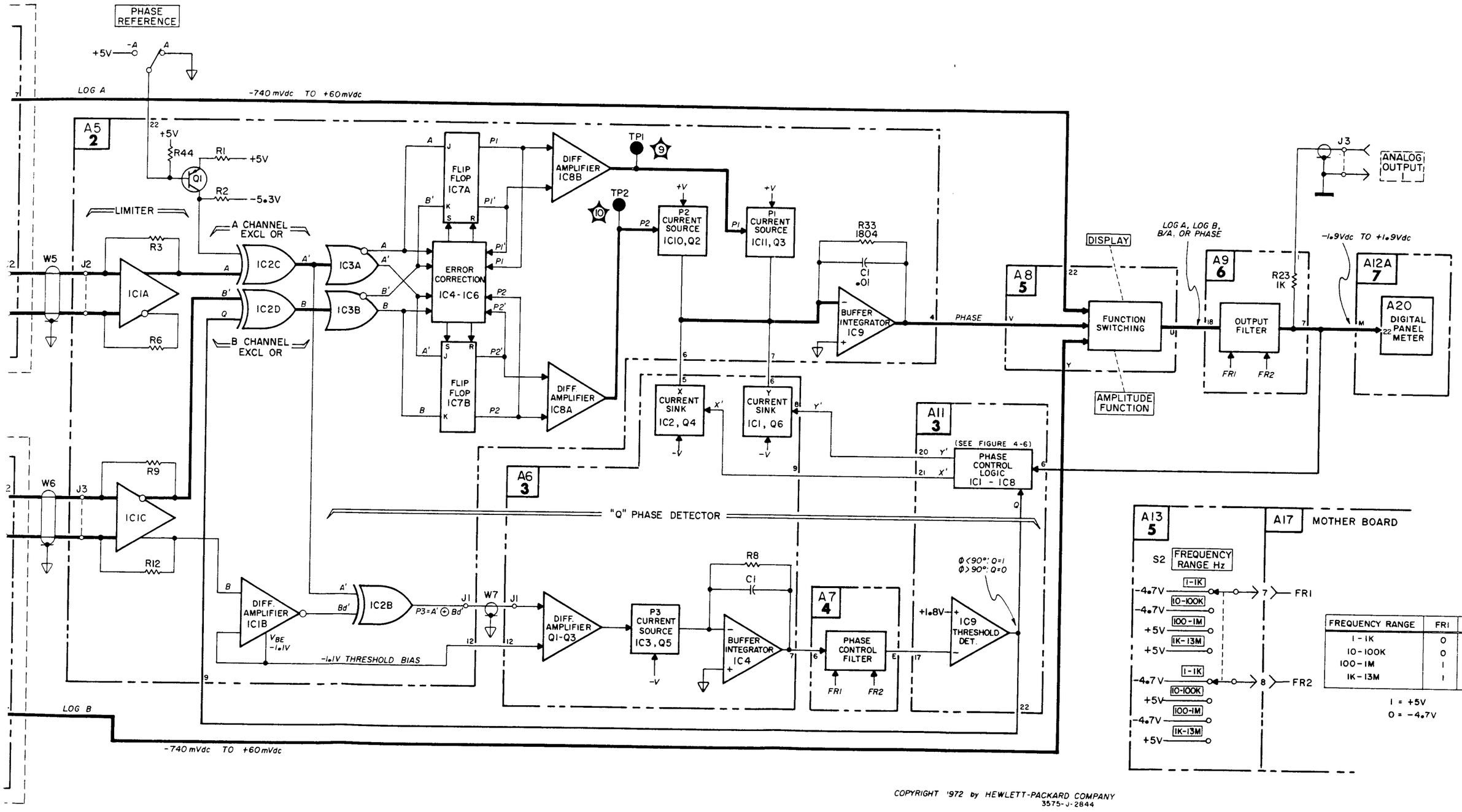
-1.1V THRESHOLD BIAS

IC2B

$P3 = A' \oplus Bd'$

W7

DIFF. AMPLIFIER Q1-Q3

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3575-J-2844

Figure 7-1. Functional Block Diagram.

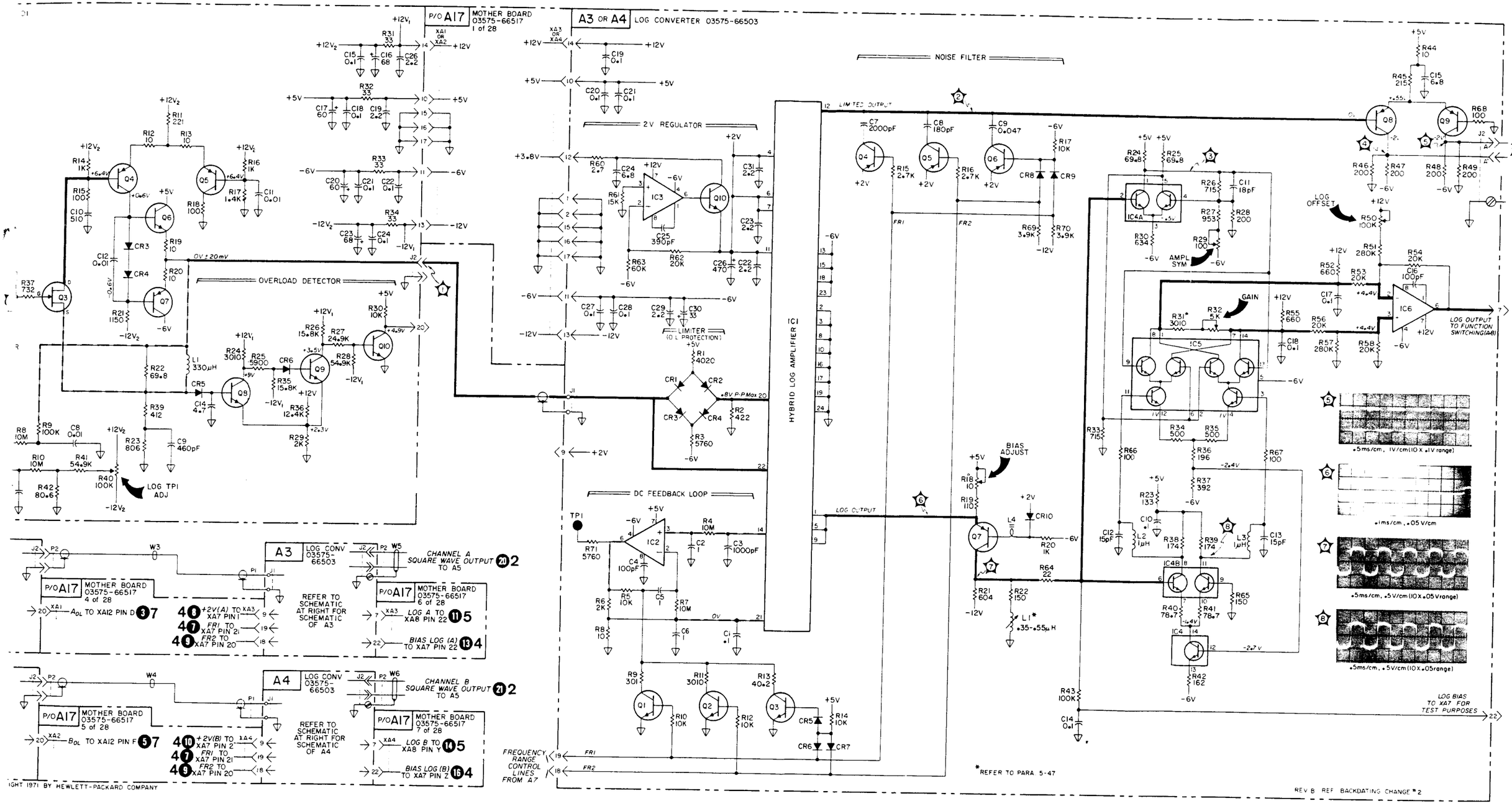
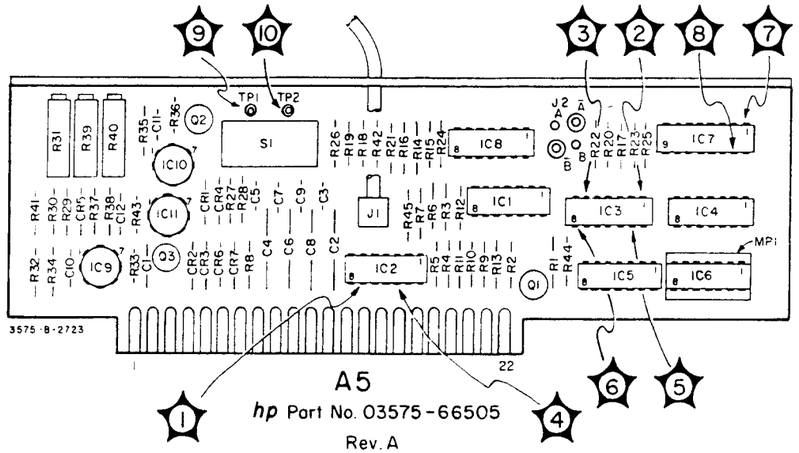
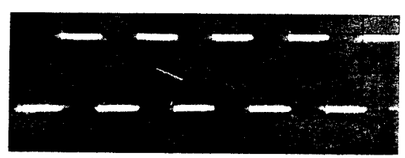

P/O A17 MOTHER BOARD 03575-66517 1 of 28
A3 OR A4 LOG CONVERTER 03575-66503
NOISE FILTER
2V REGULATOR
OVERLOAD DETECTOR
LIMITER (O.L. PROTECTION)
DC FEEDBACK LOOP
HYBRID LOG AMPLIFIER IC1
LIMITED OUTPUT
LOG OUTPUT
BIAS ADJUST
LOG TPI ADJ
LOG OFFSET
AMPL SYM
GAIN
LOG OUTPUT TO FUNCTION SWITCHING(A8)
LOG BIAS TO XA7 FOR TEST PURPOSES
CHANNEL A SQUARE WAVE OUTPUT TO A5
CHANNEL B SQUARE WAVE OUTPUT TO A5
REFER TO SCHEMATIC AT RIGHT FOR SCHEMATIC OF A3
REFER TO SCHEMATIC AT RIGHT FOR SCHEMATIC OF A4
FREQUENCY RANGE CONTROL LINES FROM A7
*REFER TO PARA 5-47
REV B REF BACKDATING CHANGE #2
IGHT 1971 BY HEWLETT-PACKARD COMPANY

Figure 7-2. Preamplifier (A1/A2) and Log Converter (A3/A4) Schematics and Component Location Diagrams.

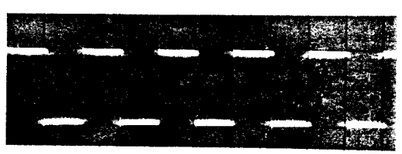



1 2 6 8 & 10

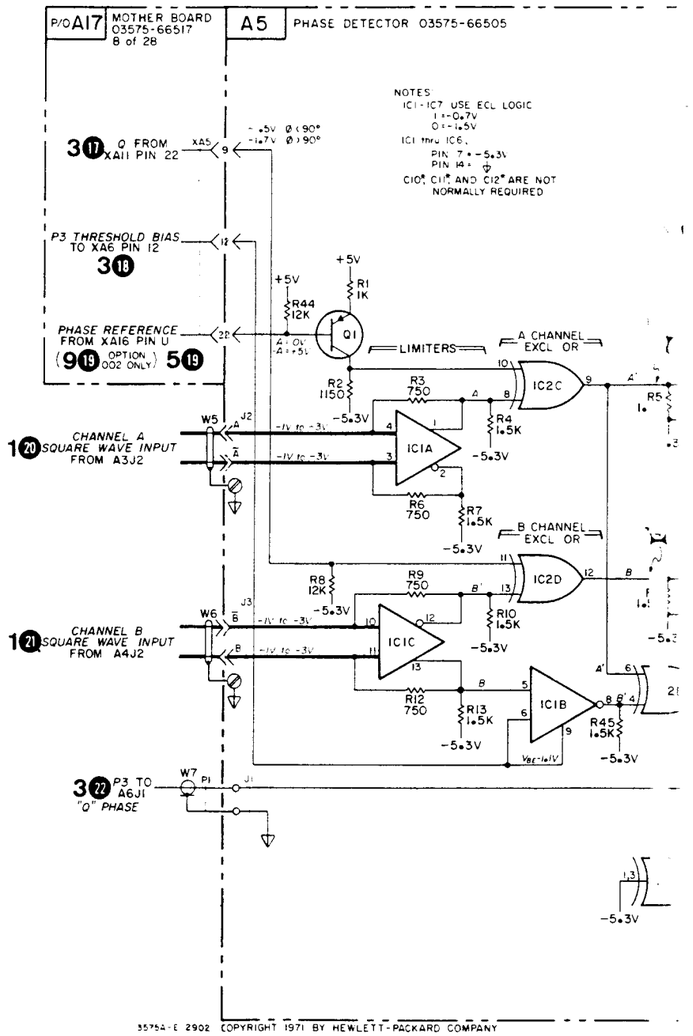


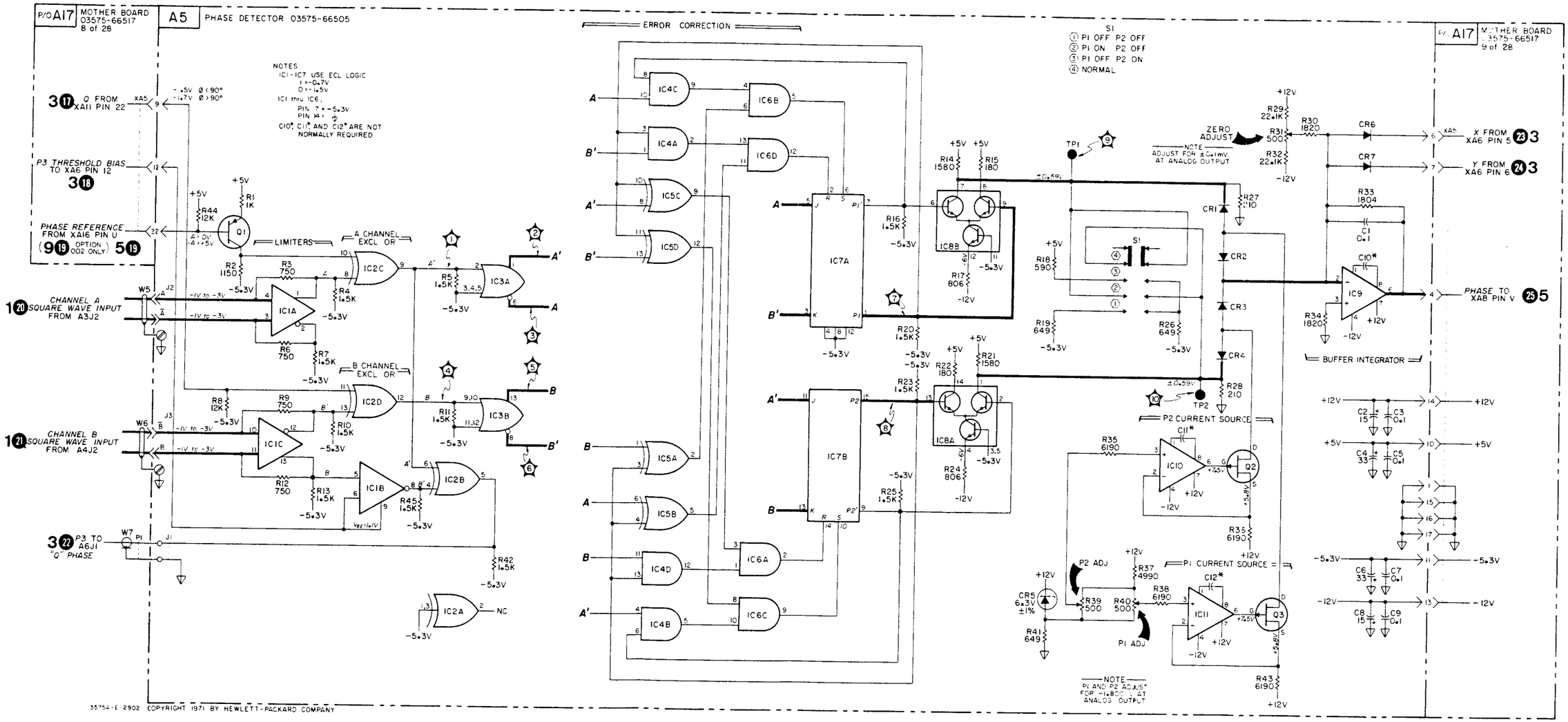
.5 ms/cm, .5 V/cm (10x .05 range)

3 4 5 7 & 9



.5 ms/cm, .5 V/cm (10x .05 range)




P/O A17 MOTHER BOARD 03575-66517 8 of 28
A5 PHASE DETECTOR 03575-66505
NOTES
IC1 - IC7 USE ECL LOGIC
1 = -0.7V
0 = -1.5V
IC1 thru IC6,
PIN 7 = -5.3V
PIN 14 = Ø
C10*, C11* AND C12* ARE NOT NORMALLY REQUIRED
3 17 Q FROM XA11 PIN 22
P3 THRESHOLD BIAS TO XA6 PIN 12
3 18
PHASE REFERENCE FROM XA16 PIN U
(9 19 OPTION 002 ONLY) 5 19
CHANNEL A SQUARE WAVE INPUT FROM A3J2
1 20
CHANNEL B SQUARE WAVE INPUT FROM A4J2
1 21
3 22 P3 TO A6J1 "Q" PHASE
LIMITERS
A CHANNEL EXCL OR
B CHANNEL EXCL OR
ERROR CORRECTION
S1
1 P1 OFF P2 OFF
2 P1 ON P2 OFF
3 P1 OFF P2 ON
4 NORMAL
ZERO ADJUST
NOTE
ADJUST FOR ±0.1mV AT ANALOG OUTPUT
P2 CURRENT SOURCE
P1 CURRENT SOURCE
P2 ADJ
P1 ADJ
NOTE
P1 AND P2 ADJUST FOR -1.820V AT ANALOG OUTPUT
BUFFER INTEGRATOR
X FROM XA6 PIN 5 2 3
Y FROM XA6 PIN 6 2 4
PHASE TO XA8 PIN V 2 5
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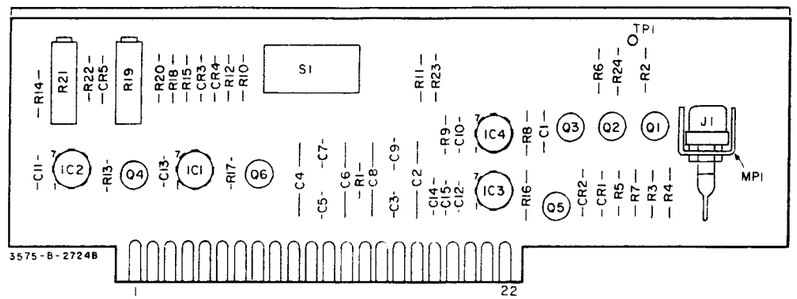
**2**

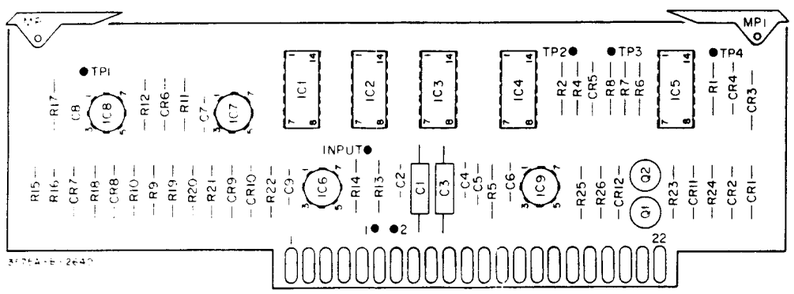
Figure 7-3. Phase Detector (A5) Schematic and Component Location Diagram.




A6

*hp* Part No. 03575-66506

Rev. B




A11

*hp* Part No. 03575-66511

Rev A

P/O A17 MOTHER BOARD 03575-66517 10 of 28

A11 PHASE LOGIC 03575-66511

2 17 Q TO XA5 PIN 9

4 26 Q PHASE DETECTOR OUTPUT (FILTERED) FROM XA7 PIN E

6 27 DC OUTPUT FROM XA9 PIN 7

6 28 DC OUTPUT FROM XA10 PIN 7 (OPTION 001 OR 002)

XA11

-+5V Ø < 90°
+1.7V Ø > 90°

CR1 CR2 CR3 CR4

R1 2.2K

TP4 +5V

TP2 TP3

R2 2.2M

IC9 -5.3V

R4 6340 +1.84V +1.71V

R5 3570

R6 162K

C6*

R7 5.6K

R8 4.7K

IC4A

CR5

NOTE
IC1-IC5, Pin 14: +5V
Pin 7: Gnd
IC1-IC5 USE TTL LOGIC
1: +2.4V to +5V
0: 0V to +0.6V
C6* thru C9* ARE NOT NORMALLY REQUIRED

IC7 -5.3V

R12 5.6K

CR6

IC1A

R11 13.3K

C7*

-0.2V -0.4V

R9 11.8K

R10 301

-12V

IC3 C

IC8 -5.3V

R18 5.6K

CR7

CR8

TP1

-1.67V -1.92V

R15 10K

R16 1910

R17 35.7K

JUMPER

INPUT

R14 1K

R13 56K

For Options 001 — 003 the JUMPER Wire is Connected Between INPUT and 2.

IC6 -5.3V

R22 5.6K

CR9

CR10

IC1C

R19 3090 +1.66V +1.91V

R20 1910

R21 26.7K

IC4B IC2B IC2C IC1B IC1D IC4D IC2A IC3D IC5A IC4C IC3B IC5D IC3A

MS PS P'S

NC

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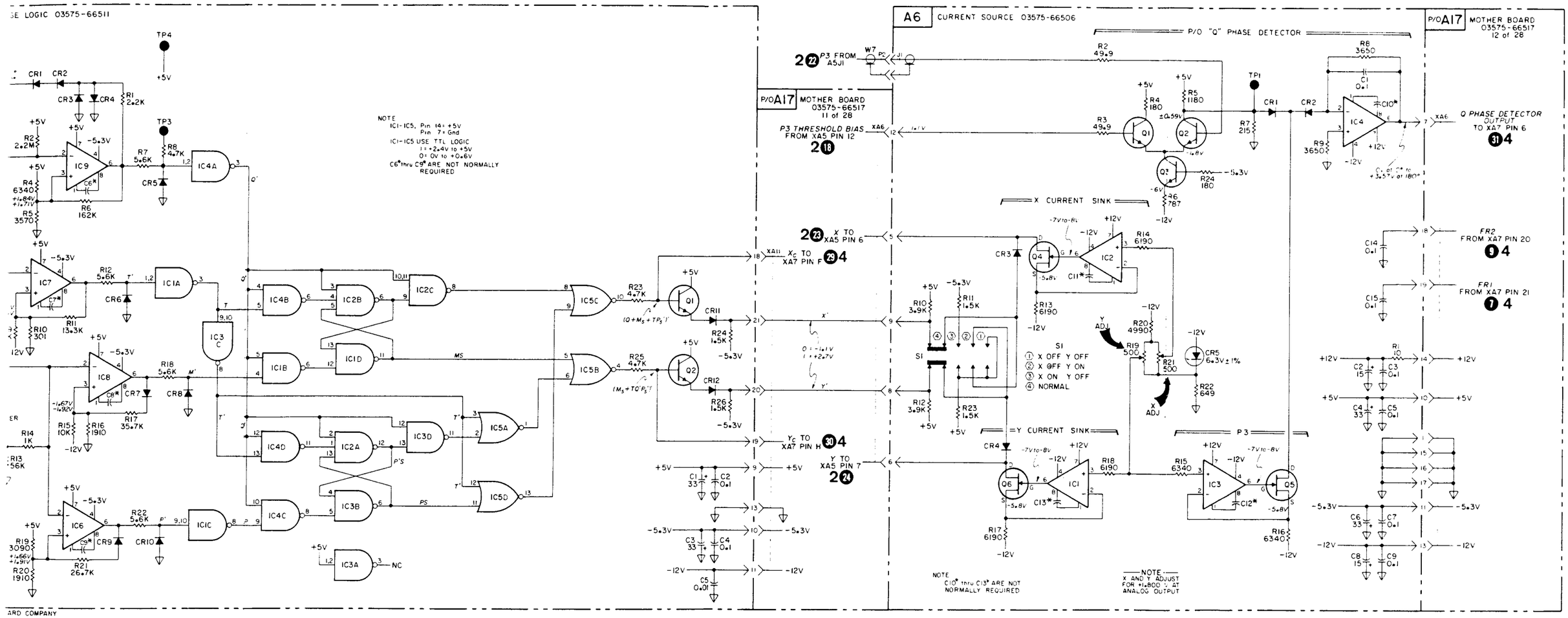
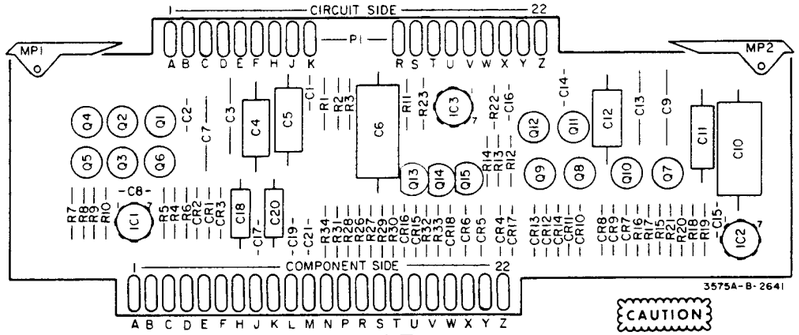

SE LOGIC 03575-66511
A6 CURRENT SOURCE 03575-66506
P/O A17 MOTHER BOARD 03575-66517 12 of 28
P/O A17 MOTHER BOARD 03575-66517 11 of 28
P/O "Q" PHASE DETECTOR
X CURRENT SINK
Y CURRENT SINK
P3
P3 FROM A5J1
P3 THRESHOLD BIAS FROM XA5 PIN 12
X TO XA5 PIN 6
Y TO XA5 PIN 7
Q PHASE DETECTOR OUTPUT TO XA7 PIN 6
FR2 FROM XA7 PIN 20
FR1 FROM XA7 PIN 21
NOTE
IC1-IC5, Pin 14= +5V
Pin 7= Gnd
IC1-IC5 USE TTL LOGIC
1= +2.4V to +5V
0= 0V to +0.6V
C6* thru C9* ARE NOT NORMALLY REQUIRED
S1
① X OFF Y OFF
② X @FF Y ON
③ X ON Y OFF
④ NORMAL
NOTE
C10* thru C13* ARE NOT NORMALLY REQUIRED
NOTE
X AND Y ADJUST FOR +1.800 V AT ANALOG OUTPUT
ARD COMPANY

Figure 7-4. Current Source (A6) and Phase Control Logic (A11) Schematics and Component Location Diagrams.




CAUTION

A7 Must be Clean Handled

A7

*hp* Part No. 03575-66507

Rev A

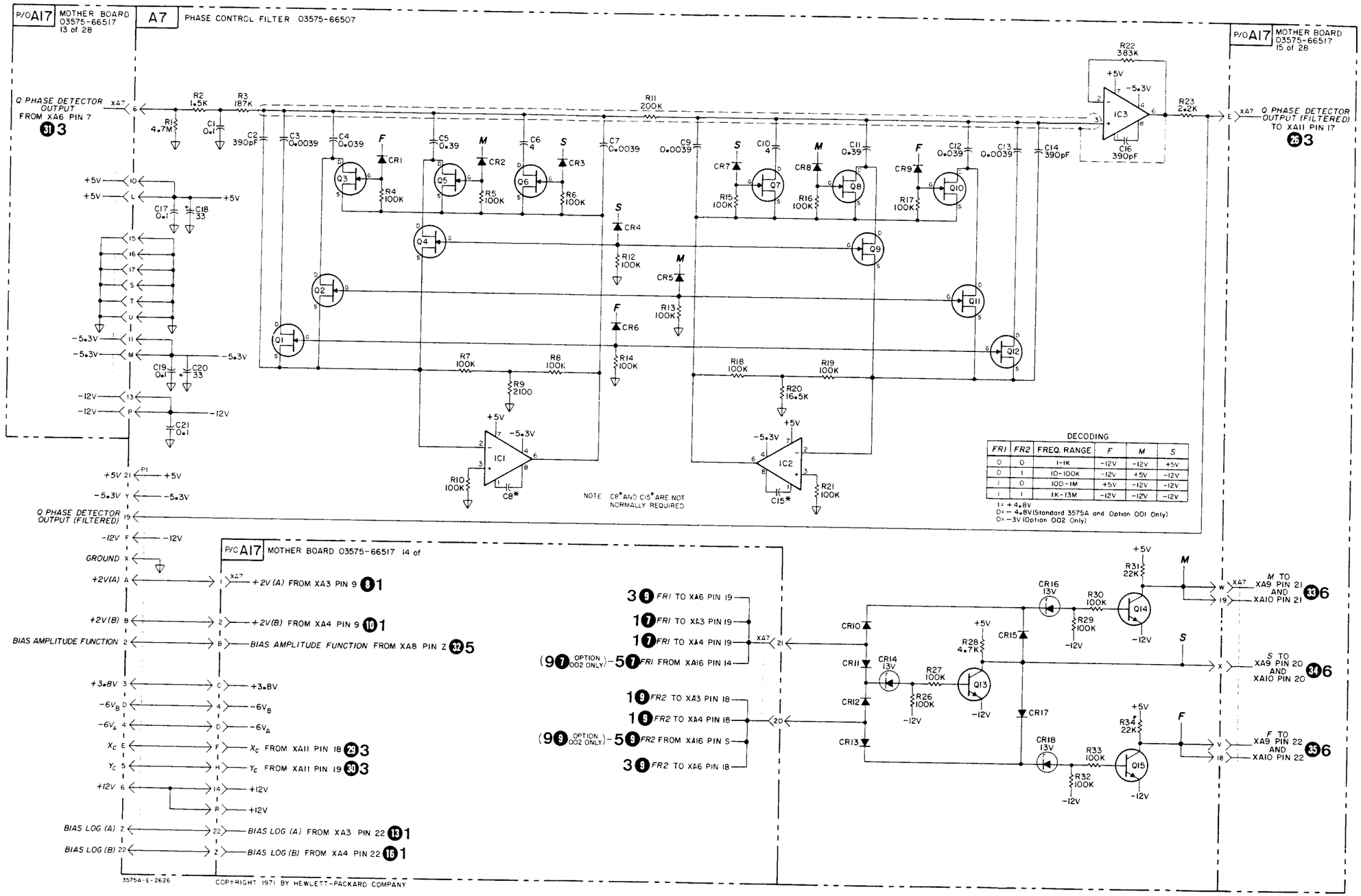

P/O A17 MOTHER BOARD 03575-66517 13 of 28
A7 PHASE CONTROL FILTER 03575-66507
P/O A17 MOTHER BOARD 03575-66517 15 of 28
Q PHASE DETECTOR OUTPUT FROM XA6 PIN 7 3
XA7 Q PHASE DETECTOR OUTPUT (FILTERED) TO XA11 PIN 17 3
Q PHASE DETECTOR OUTPUT (FILTERED)
+5V
-5.3V
-12V
GROUND
P1
P/O A17 MOTHER BOARD 03575-66517 14 of
+2V(A) FROM XA3 PIN 9 1
+2V(B) FROM XA4 PIN 9 1
BIAS AMPLITUDE FUNCTION
BIAS AMPLITUDE FUNCTION FROM XA8 PIN Z 5
+3.8V
-6V_B
-6V_A
X_C FROM XA11 PIN 18 3
Y_C FROM XA11 PIN 19 3
+12V
BIAS LOG (A) FROM XA3 PIN 22 1
BIAS LOG (B) FROM XA4 PIN 22 1
3 FR1 TO XA6 PIN 19
1 FR1 TO XA3 PIN 19
1 FR1 TO XA4 PIN 19
(9 OPTION 002 ONLY) - 5 FR1 FROM XA16 PIN 14
1 FR2 TO XA3 PIN 18
1 FR2 TO XA4 PIN 18
(9 OPTION 002 ONLY) - 5 FR2 FROM XA16 PIN 5
3 FR2 TO XA6 PIN 18
M TO XA9 PIN 21 AND XA10 PIN 21 6
S TO XA9 PIN 20 AND XA10 PIN 20 6
F TO XA9 PIN 22 AND XA10 PIN 22 6
NOTE C8* AND C15* ARE NOT NORMALLY REQUIRED
DECODING
FR1 FR2 FREQ. RANGE F M S
0 0 1-1K -12V -12V +5V
0 1 10-100K -12V +5V -12V
1 0 100-1M +5V -12V -12V
1 1 1K-13M -12V -12V -12V
1 = +4.8V
0 = -4.8V (Standard 3575A and Option 001 Only)
0 = -3V (Option 002 Only)
3575A-E-2626
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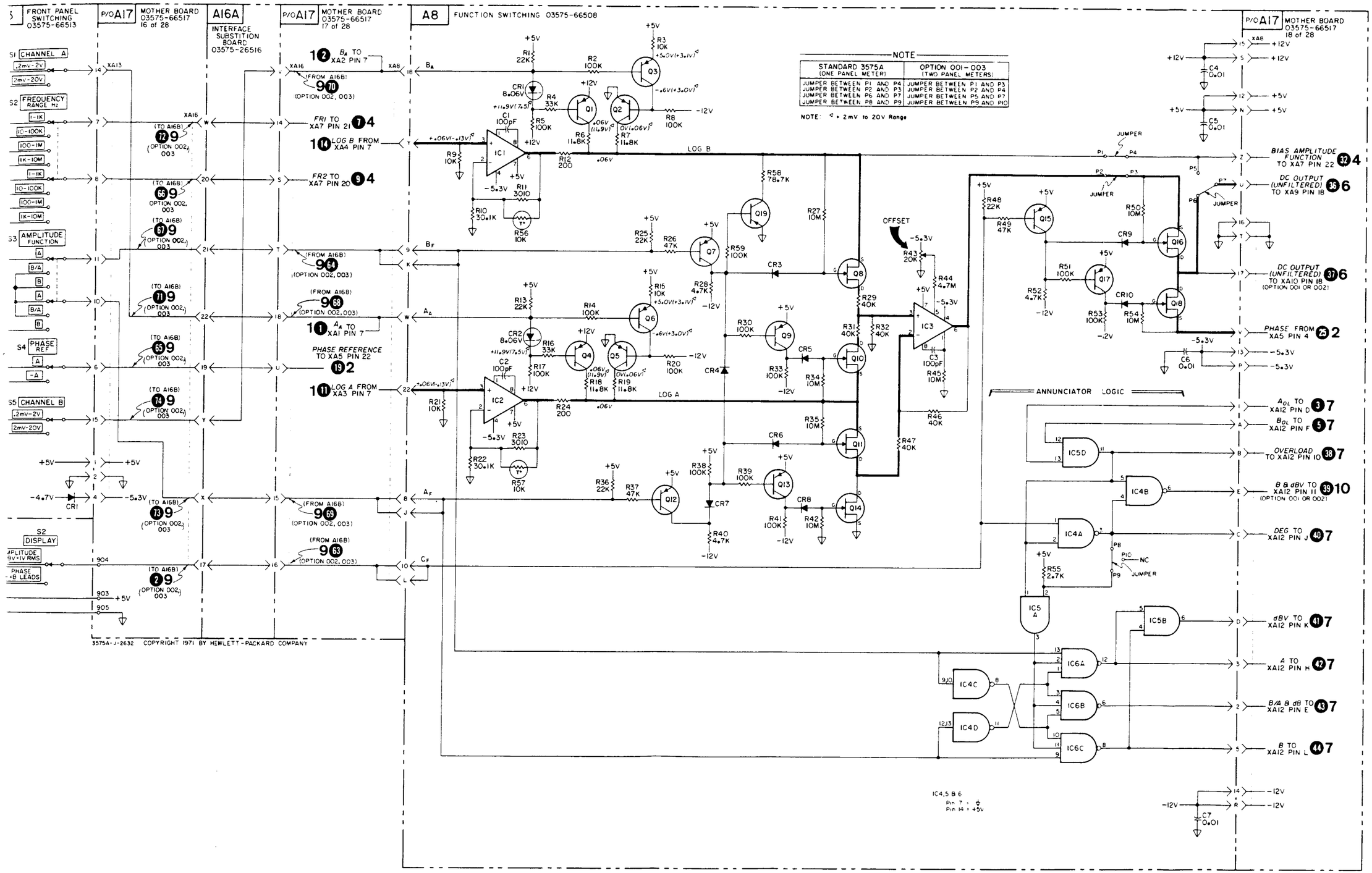
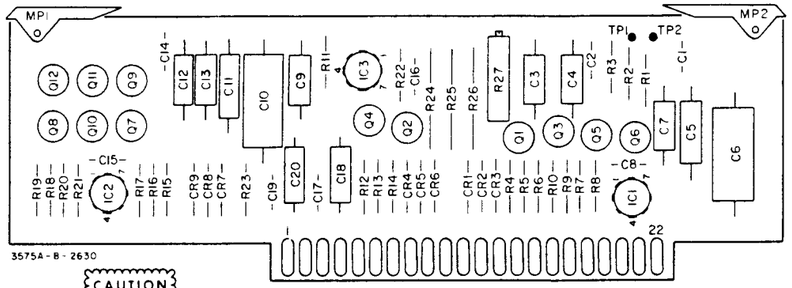
Figure 7-5. Phase Control Filter (A7) Schematic and Component Location Diagram.




5

Figure 7-6. Function Switching (A8) and Front Panel Switching (A13) Schematics and Component Location Diagrams.




CAUTION

A9/A10 Must be Clean Handled

A9 or A10

*hp* Part No. 03575-66509

Rev A

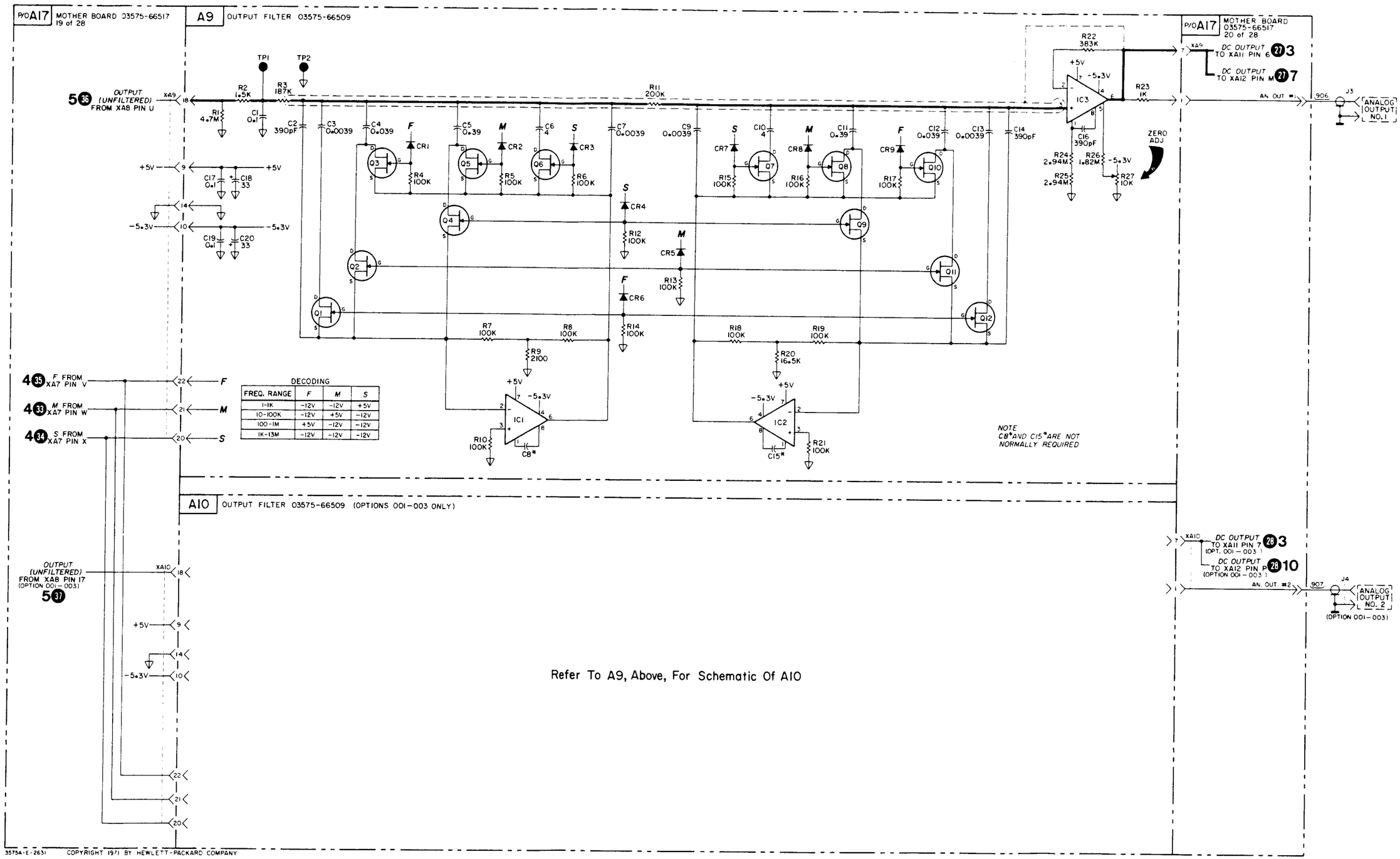
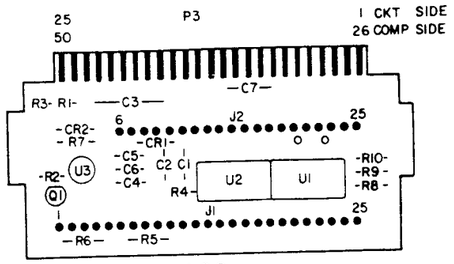
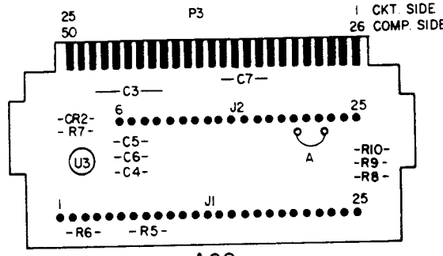

P/O A17 MOTHER BOARD 03575-66517 19 of 28
A9 OUTPUT FILTER 03575-66509
P/O A17 MOTHER BOARD 03575-66517 20 of 28
OUTPUT (UNFILTERED) FROM XA8 PIN U
DC OUTPUT TO XA11 PIN 6
DC OUTPUT TO XA12 PIN M
AN. OUT #1
ANALOG OUTPUT NO. 1
ZERO ADJ
F FROM XA7 PIN V
M FROM XA7 PIN W
S FROM XA7 PIN X
DECODING
FREQ. RANGE | F | M | S
1-1K | -12V | -12V | +5V
10-100K | -12V | +5V | -12V
100-1M | +5V | -12V | -12V
1K-13M | -12V | -12V | -12V
NOTE C8* AND C15* ARE NOT NORMALLY REQUIRED
A10 OUTPUT FILTER 03575-66509 (OPTIONS 001-003 ONLY)
OUTPUT (UNFILTERED) FROM XA8 PIN 17 (OPTION 001-003)
DC OUTPUT TO XA11 PIN 7 (OPT. 001-003)
DC OUTPUT TO XA12 PIN P (OPTION 001-003)
AN. OUT. #2
ANALOG OUTPUT NO. 2 (OPTION 001-003)
Refer To A9, Above, For Schematic Of A10
3575A-E-2631 COPYRIGHT 1971 BY HEWLETT-PACKARD COMPANY

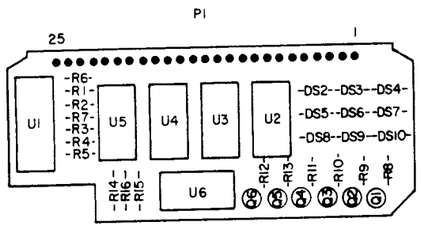
Figure 7-7. Output Filter (A9/A10) Schematic and Component Location Diagram.



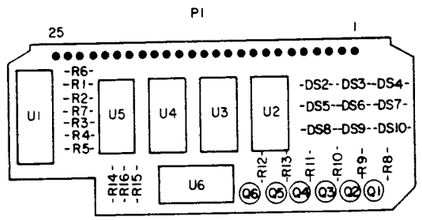

A20
hp Part No. 5061-0741



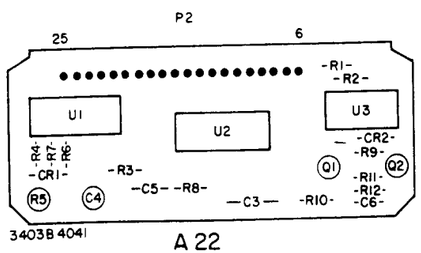

A20
hp Part No. 5061-0747



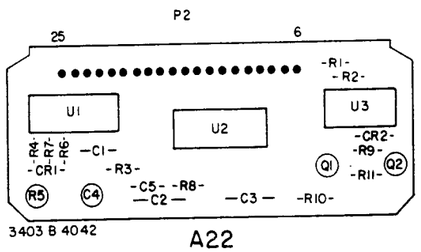

A21
hp Part No. 5061-0740



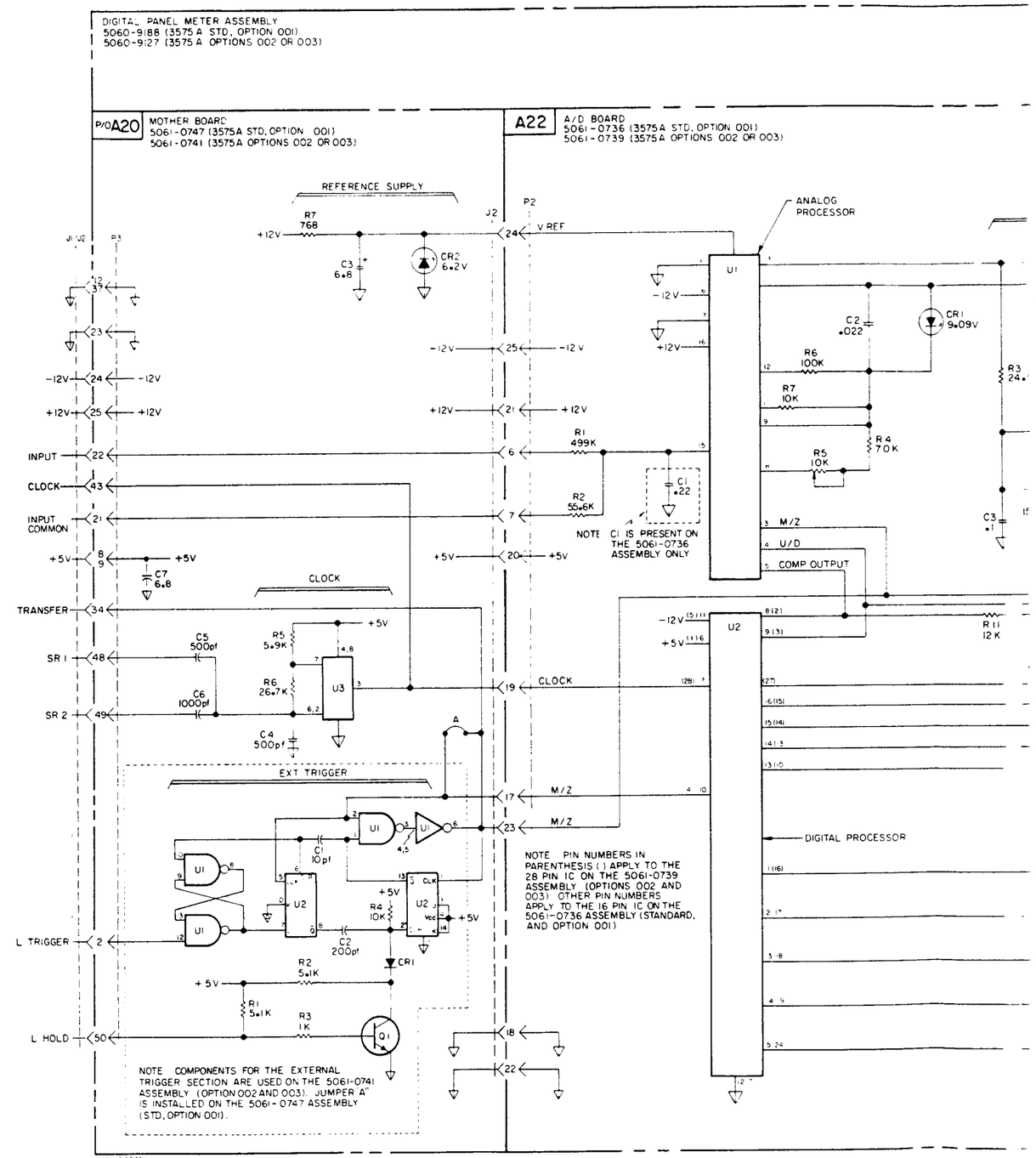

A21
hp Part No. 5061-0740




A 22
hp Part No. 5061-0739




A22
hp Part No. 5061-0736



A22 A/D BOARD
5061-0736 (3575A STD, OPTION 001)
5061-0739 (3575A OPTIONS 002 OR 003)

P/O A20 MOTHER BOARD

A21 DISPLAY BOARD
5061-0740

P/O A20 MOTHER BOARD

ANALOG PROCESSOR

OVERRIDE

ACTUAL ARRANGEMENT OF PANEL METER DIGITS

| DIGIT 4 | DIGIT 3 | DIGIT 2 | DIGIT 1 |
|---|---|---|---|

ANNUNCIATORS

NOTE C1 IS PRESENT ON THE 5061-0736 ASSEMBLY ONLY

NOTE C6 AND R12 ARE PRESENT FOR THE 5061-0739 ASSEMBLY ONLY (OPTIONS 002 AND 003).

NOTE PIN NUMBERS IN PARENTHESIS ( ) APPLY TO THE 28 PIN IC ON THE 5061-0739 ASSEMBLY (OPTIONS 002 AND 003) OTHER PIN NUMBERS APPLY TO THE 16 PIN IC ON THE 5061-0736 ASSEMBLY (STANDARD, AND OPTION 001)

DIGITAL PROCESSOR

DECODER DRIVE

DIGIT 1

DIGIT 2

DIGIT 3

DIGIT 4

POLARITY SIGN BLANKING

L DIGIT BLANK

H± BLANK

L DEC 1

L DEC 2

L DEC 3

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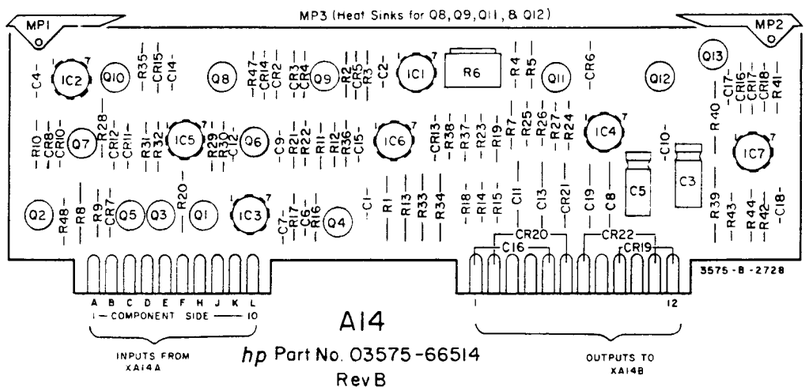
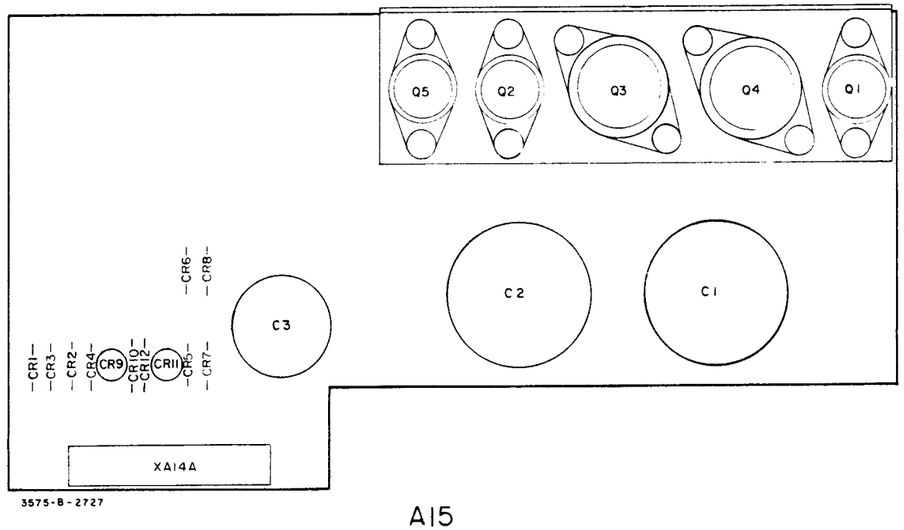
Figure 7-8. Panel Meter (A20, A21, A22) Schematics and Component Location Diagrams.




A14

*hp* Part No. 03575-66514

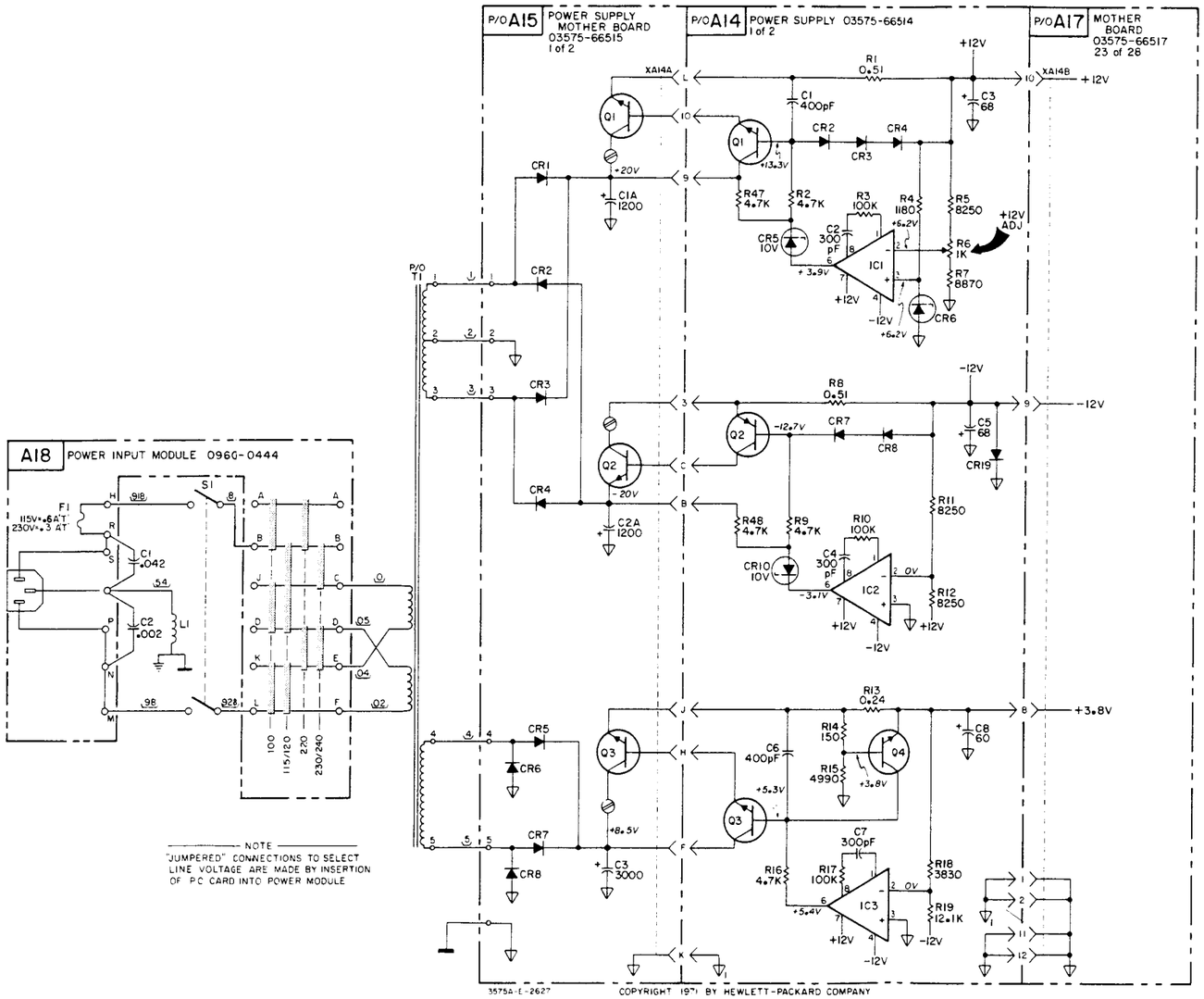
Rev B




A15

*hp* Part No. 03575-66515

Rev. A


P/O A15 POWER SUPPLY MOTHER BOARD 03575-66515 1 of 2
P/O A14 POWER SUPPLY 03575-66514 1 of 2
P/O A17 MOTHER BOARD 03575-66517 23 of 28
A18 POWER INPUT MODULE 0960-0444
NOTE
"JUMPERED" CONNECTIONS TO SELECT LINE VOLTAGE ARE MADE BY INSERTION OF PC CARD INTO POWER MODULE
3575A-E-2627
COPYRIGHT 1971 BY HEWLETT-PACKARD COMPANY

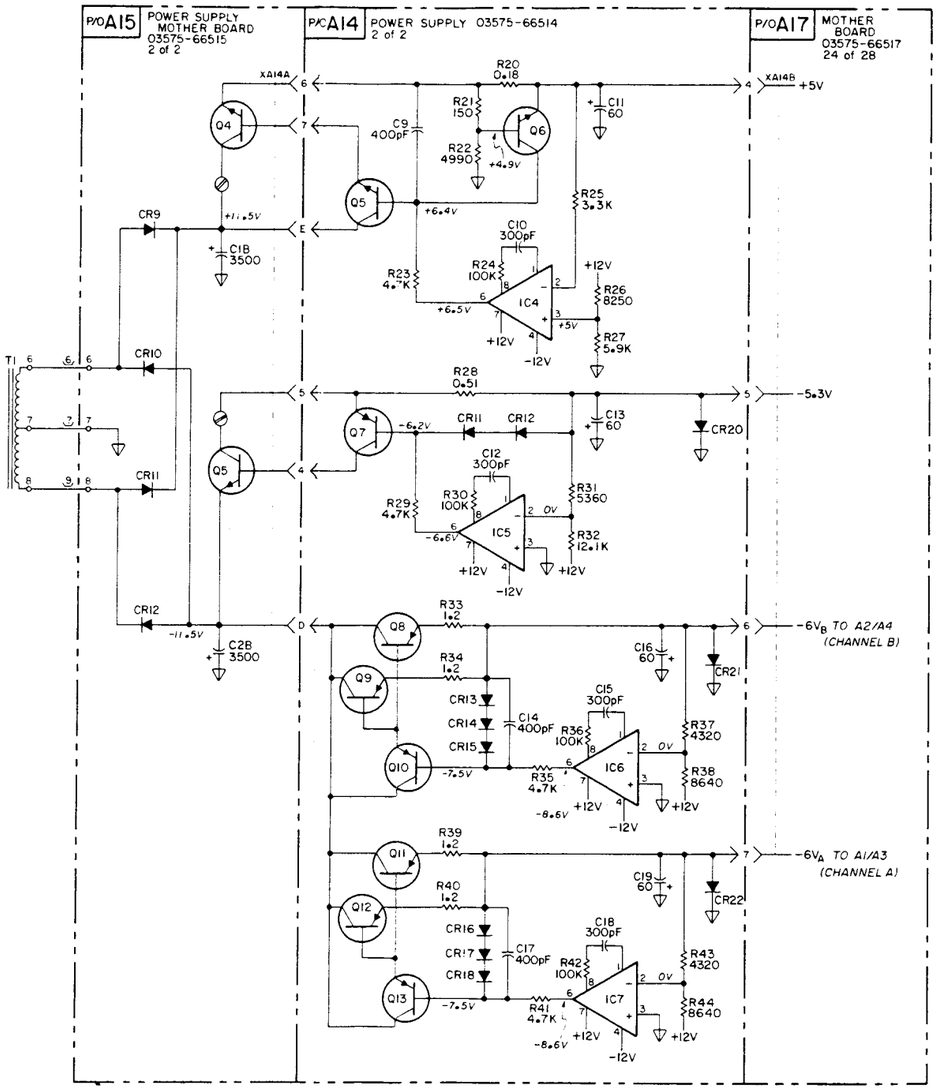
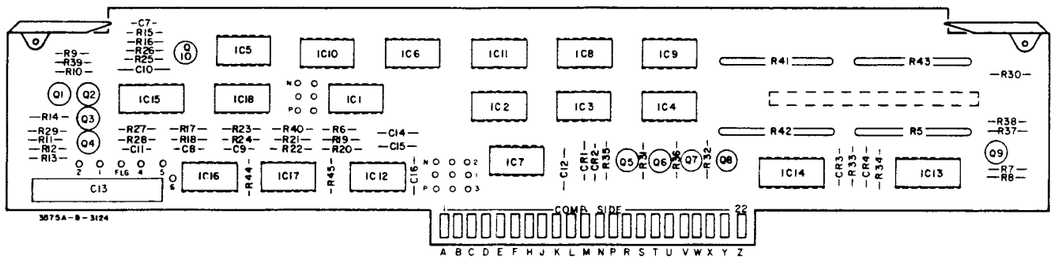

P/O A15 POWER SUPPLY MOTHER BOARD 03575-66515 2 of 2
P/O A14 POWER SUPPLY 03575-66514 2 of 2
P/O A17 MOTHER BOARD 03575-66517 24 of 28

Figure 7-9. Power Supply (A14) and Power Supply Mother Board (A15) Schematics and Component Location Diagrams.




A16B or A16C

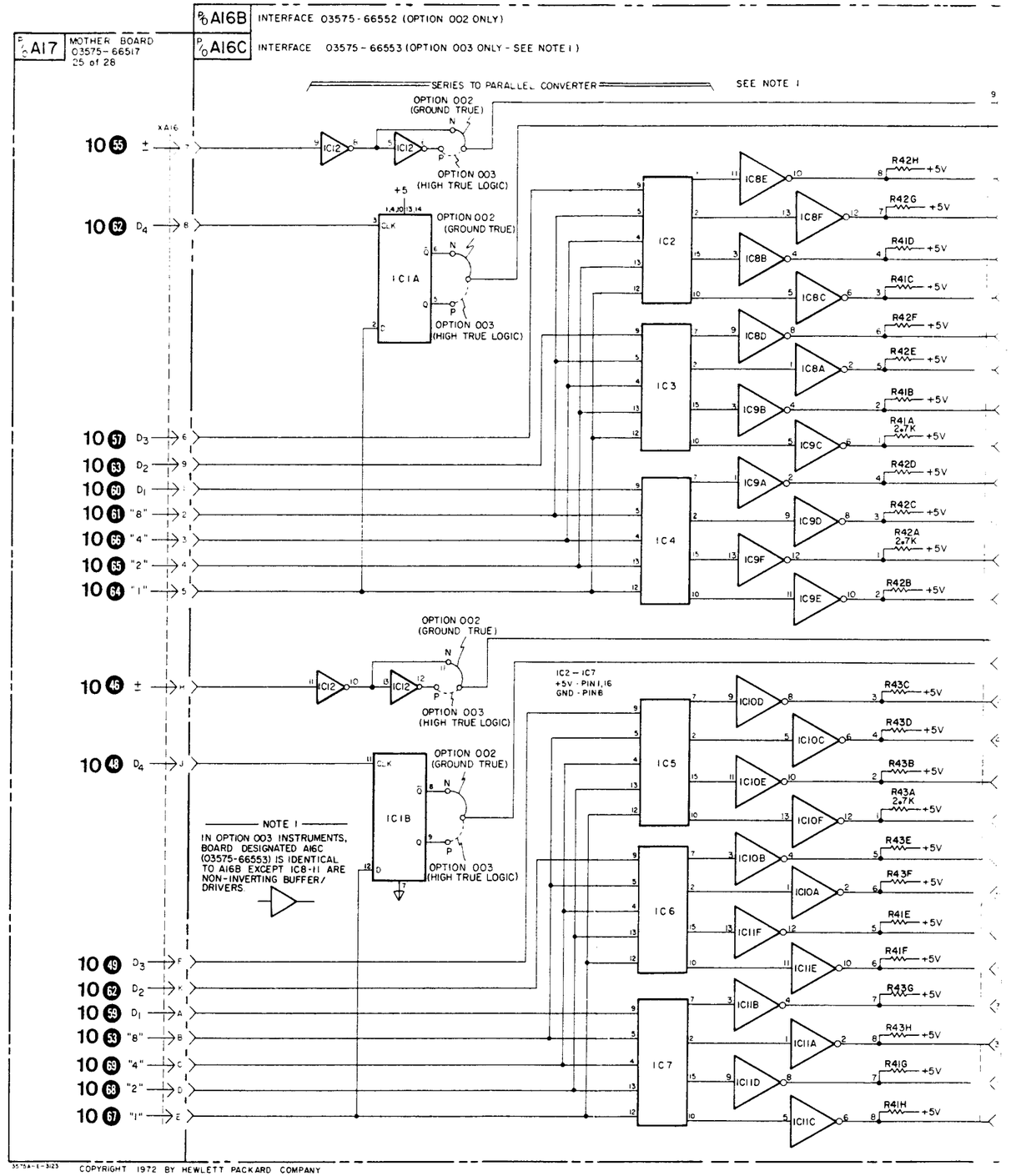
*hp* Part No. 03575-66552 (B) OPT 002
66553 (C) OPT 003

Rev. A

| Front Panel Switch | Signal Name | Position for an UP Level | XA16 Input Local | J1 Input Remote | XA16 Output |
|---|---|---|---|---|---|
| PHASE/AMP | CF | PHASE | 17 | 9 | 16 |
| CHANNEL A | AA | .2 mV - 2 V | 22 | 34 | 18 |
| FREQ. RANGE | FR1 | 100 - 1 MHz<br>1 kHz - 13 MHz | W | 35 | 14 |
| | FR2 | 10 Hz - 100 kHz<br>1 kHz - 13 MHz | 20 | 11 | S |
| AMP FUNCTION | AF | B | X | 36 | 15 |
| | BF | A | 21 | 12 | T |
| PHASE REF | Q REF | - A | 19 | 10 | U |
| CHANNEL B | BA | .2 mV - 2 V | Y | 37 | V |

Up Levels must be + 4.8 V.

**Table 7-3. Truth Table for Remote.**



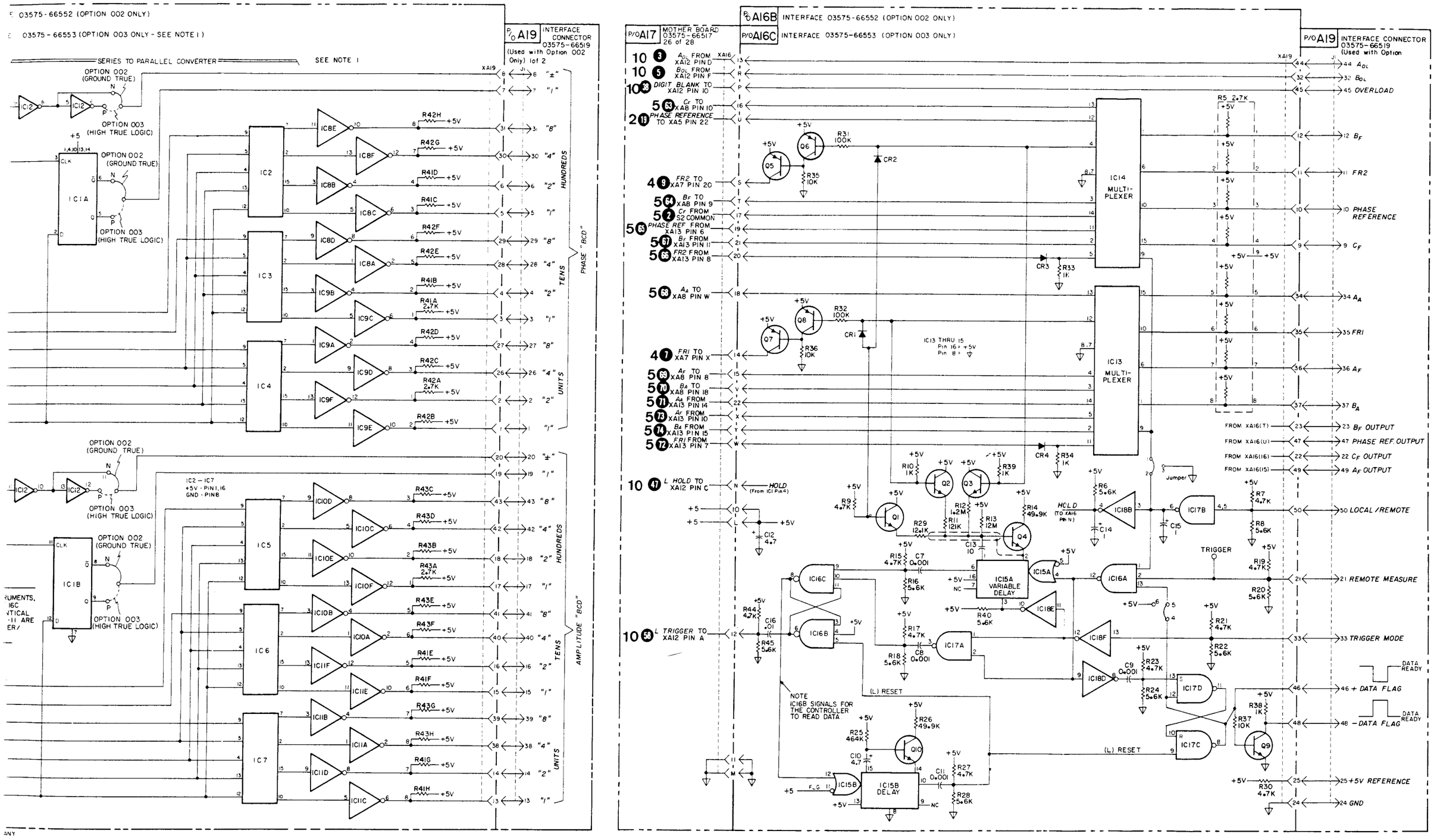
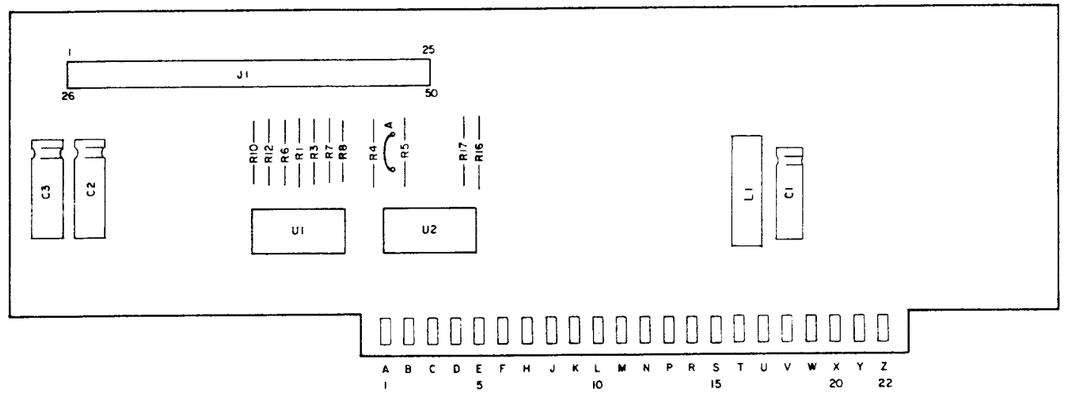
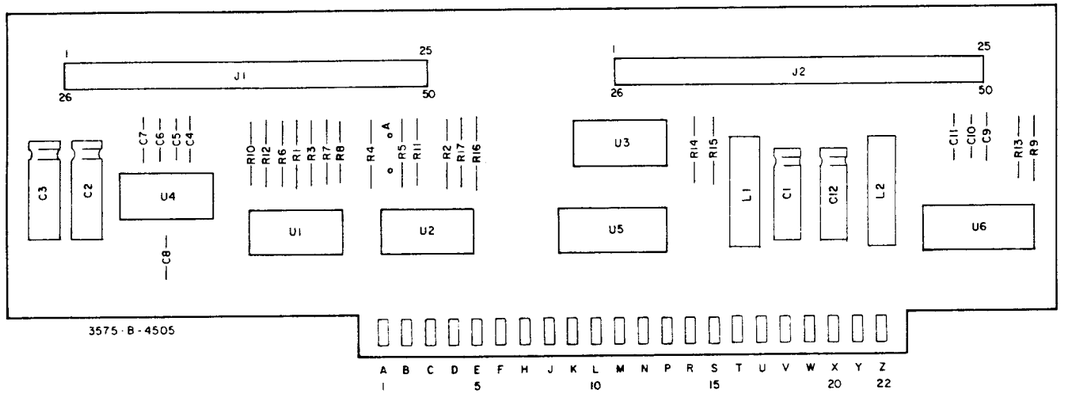



Figure 7-10. Interface Board A16B (Option 002) or A16C (Option 003) Schematic and Component Location Diagram.




**A12A**

*hp* Part No. 03575-66550




**A12B**

*hp* Part No. 03575-66551

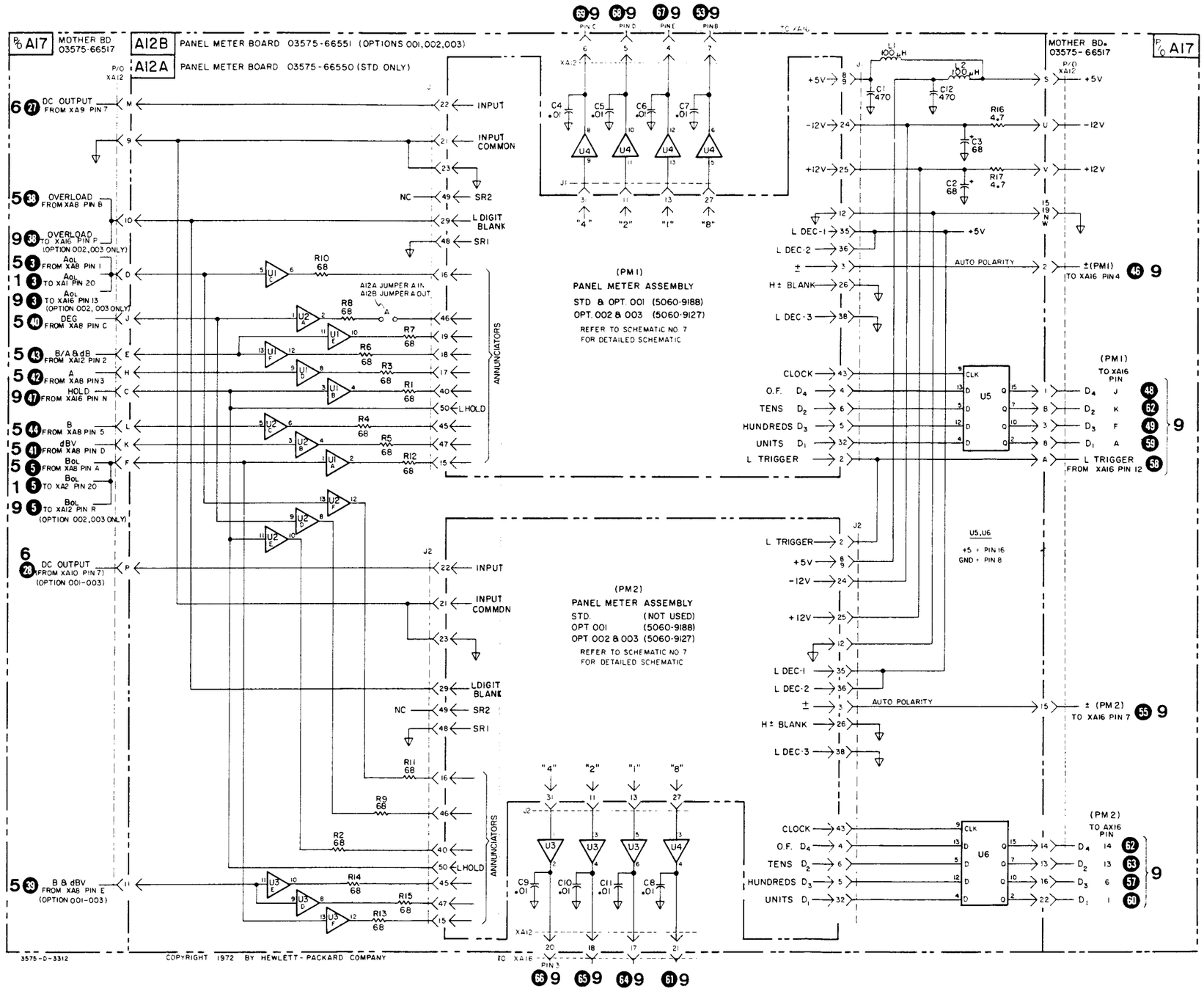



Figure 7-11. Panel Meter Connector (A12A and A12B) Schematics and Component Location Diagrams.

# CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

| Code No. | Manufacturer | Address |
|---|---|---|
| 00000 | U. S. A Common | Any supplier of U.S. |
| 00136 | McCoy Electronics | Mount Holly Springs, Pa. |
| 00213 | Sage Electronics Corp. | Rochester, N.Y. |
| 00287 | Cemco, Inc. | Danielson, Conn. |
| 00334 | Humidial | Colton, Calif. |
| 00348 | Mictron, Co., Inc. | Valley Stream, N.Y. |
| 00373 | Garlock Inc. | Cherry Hill, N.J. |
| 00656 | Aerovox Corp. | New Bedford, Mass. |
| 00779 | Amp, Inc. | Harrisburg, Pa. |
| 00781 | Aircraft Radio Corp. | Boonton, N.J. |
| 00809 | Croven, Ltd. | Whitby, Ontario, Canada |
| 00815 | Northern Engineering Laboratories, Inc. | Burlington, Wis. |
| 00853 | Sangamo Electric Co., Pickens Div. | Pickens, S.C. |
| 00866 | Goe Engineering Co. | City of Industry, Cal. |
| 00891 | Carl E. Holmes Corp. | Los Angeles, Cal. |
| 00929 | Microlab Inc. | Livingston, N.J. |
| 01002 | General Electric Co., Capacitor Dept. | Hudson Falls, N.Y. |
| 01009 | Alden Products Co. | Brockton, Mass. |
| 01121 | Allen Bradley Co. | Milwaukee, Wis. |
| 01255 | Litton Industries, Inc. | Beverly Hills, Cal. |
| 01281 | TRW Semiconductors, Inc. | Lawndale, Cal. |
| 01295 | Texas Instruments, Inc., Transistor Products Div. | Dallas, Texas |
| 01349 | The Alliance Mfg. Co | Alliance, Ohio |
| 01538 | Small Parts Inc. | Los Angeles, Cal. |
| 01589 | Pacific Relays, Inc. | Van Nuys, Cal. |
| 01670 | Gudebrod Bros. Silk Co. | New York, N.Y. |
| 01930 | Amerock Corp. | Rockford, Ill. |
| 01960 | Pulse Engineering Co | Santa Clara, Cal. |
| 02114 | Ferroxcube Corp. of America | Saugerties, N.Y. |
| 02116 | Wheelock Signals, Inc. | Long Branch, N.J. |
| 02286 | Cole Rubber and Plastics Inc. | Sunnyvale, Cal. |
| 02660 | Amphenol-Borg Electronics Corp. | Broadview, Ill. |
| 02735 | Radio Corp. of America, Semiconductor and Materials Division | Somerville, N.J. |
| 02771 | Vocaline Co. of America, Inc. | Old Saybrook, Conn. |
| 02777 | Hopkins Engineering Co. | San Fernando, Cal. |
| 02875 | Hudson Tool & Die | Newark, N.J. |
| 03296 | Nylon Molding Corp. | Springfield, N.J. |
| 03508 | G.E. Semiconductor Prod. Dept. | Syracuse, N.Y. |
| 03705 | Apex Machine & Tool Co. | Dayton, Ohio |
| 03797 | Eldema Corp. | Compton, Calif. |
| 03818 | Parker Seal Co. | Los Angeles, Cal. |
| 03877 | Transitron Electric Corp. | Wakefield, Mass. |
| 03888 | Pyrofilm Resistor Co., Inc. | Cedar Knolls, N.J. |
| 03954 | Singer Co., Diehl Div., Finderne Plant | Sumerville, N.J. |
| 04009 | Arrow, Hart and Hegeman Elect. Co. | Hartford, Conn. |
| 04013 | Taruus Corp. | Lambertville, N.J. |
| 04062 | Arco Electronic Inc. | Great Neck, N.Y. |
| 04217 | Essex Wire | Los Angeles, Cal. |
| 04222 | Hi-Q Division of Aerovox | Myrtle Beach, S.C. |
| 04354 | Precision Paper Tube Co. | Wheeling, Ill. |
| 04404 | Palo Alto Division of Hewlett-Packard Co. | Palo Alto, Cal. |
| 04651 | Sylvania Electric Products, Microwave Device Div. | Mountain View, Cal. |
| 04673 | Dakota Engr. Inc. | Culver City, Cal. |
| 04713 | Motorola Inc. Semiconductor Prod. Div. | Phoenix, Arizona |
| 04732 | Filtron Co., Inc. Western Div. | Culver City, Cal. |
| 04773 | Automatic Electric Co. | Northlake, Ill. |
| 04796 | Sequoia Wire Co. | Redwood City, Cal. |
| 04811 | Precision Coil Spring Co. | El Monte, Cal. |
| 04870 | P.M. Motor Company | Westchester, Ill. |
| 04919 | Component Mfg. Service Co. | W. Bridgewater, Mass. |
| 05006 | Twentieth Century Plastics, Inc. | Los Angeles, Cal. |
| 05277 | Westinghouse Electric Corp. Semiconductor Dept. | Youngwood, Pa. |
| 05347 | Ultronix, Inc. | San Mateo, Cal. |
| 05397 | Union Carbine Corp., Elect. Div. | New York, N.Y. |
| 05574 | Viking Ind. Inc. | Canoga Park, Cal. |
| 05593 | Icore Electro-Plastics Inc. | Sunnyvale, Cal. |
| 05616 | Cosmo Plastic (c/o Electrical Spec. Co.) | Cleveland, Ohio |
| 05624 | Barber Colman Co. | Rockford, Ill. |
| 05728 | Tiffen Optical Co. | Roslyn Heights, Long Island, N.Y. |
| 05729 | Metro-Tel Corp. | Westbury, N.Y. |
| 05783 | Stewart Engineering Co. | Santa Cruz, Cal. |
| 05820 | Wakefield Engineering Inc. | Wakefield, Mass. |
| 06004 | Bassick Co., Div. of Stewart Warner Corp | Bridgeport, Conn. |
| 06090 | Raychem Corp. | Redwood City, Cal. |
| 06175 | Bausch and Lomb Optical Co. | Rochester, N.Y. |
| 06402 | E.T.A. Products Co. of America | Chicago, Ill. |
| 06540 | Amatom Electronic Hardware Co., Inc. | New Rochelle, N.Y. |
| 06555 | Beede Electrical Instrument Co., Inc. | Penacook, N.H. |
| 06666 | General Devices Co., Inc. | Indianapolis, Ind. |
| 06751 | Components Inc., Ariz. Div. | Phoenix, Arizona |
| 06812 | Torrington Mfg. Co., West Div. | Van Nuys, Cal. |
| 06980 | Varian Assoc. Etmac Div. | San Carlos, Cal. |
| 07088 | Kelvin Electric Co. | Van Nuys, Cal. |
| 07126 | Digitran Co. | Pasadena, Cal. |
| 07137 | Transistor Electronics Corp. | Minneapolis, Minn. |
| 07138 | Westinghouse Electric Corp., Electronic Tube Div. | Elmira, N.Y. |
| 07149 | Filmohm Corp. | New York, N.Y. |
| 07233 | Cinch-Graphik Co. | City of Industry, Cal. |
| 07256 | Silicon Transistor Corp. | Carle Place, N.Y. |
| 07261 | Avnet Corp. | Culver City, Cal. |
| 07263 | Fairchild Camera & Inst. Corp., Semiconductor Div. | Mountain View, Cal. |
| 07322 | Minnesota Rubber Co. | Minneapolis, Minn. |
| 07387 | Birtcher Corp, The | Monterey Park, Cal. |
| 07397 | Sylvania Elect. Prod. Inc., Mt. View Operations | Mountain View, Cal. |
| 07700 | Technical Wire Products Inc. | Cranford, N.J. |
| 07829 | Bodine Elect. Co. | Chicago, Ill. |
| 07910 | Continental Device Corp. | Hawthorne, Cal. |
| 07933 | Raytheon Mfg. Co., Semiconductor Div. | Mountain View, Cal. |
| 07980 | Hewlett-Packard Co., New Jersey Division | Rockaway, N.J. |
| 08145 | U.S. Engineering Co. | Los Angeles, Cal. |
| 08289 | Blinn, Delbert Co. | Pomona, Cal. |
| 08358 | Burgess Battery Co. | Niagara Falls, Ontario, Canada |
| 08524 | Deutsch Fastener Corp. | Los Angeles, Cal. |
| 08664 | Bristol Co., The | Waterbury, Conn. |
| 08717 | Sloan Company | Sun Valley, Cal. |
| 08718 | ITT Cannon Electric Inc., Phoenix Div. | Phoenix, Arizona |
| 08727 | National Radio Lab. Inc. | Paramus, N.J. |
| 08792 | CBS Electronics Semiconductor Operations, Div. of CBS Inc | Lowell, Mass. |
| 08806 | General Electric Co., Miniature Lamp Dept. | Cleveland, Ohio |
| 08984 | Mel-Rain | Indianapolis, Ind. |
| 09026 | Babcock Relays Div. | Costa Mesa, Cal. |
| 09097 | Electronic Enclosures Inc. | Los Angeles, Calif. |
| 09134 | Texas Capacitor Co. | Houston, Texas |
| 09145 | Tech. Ind. Inc. Atohm Elect. | Burbank, Cal. |
| 09250 | Electro Assemblies, Inc. | Chicago, Ill. |
| 09353 | C & K Components Inc. | Newton, Mass. |
| 09569 | Mallory Battery Co. of Canada, Ltd. | Toronto, Ontario, Canada |
| 09795 | Pennsylvania Florocarbon Clifton Heights, Penn. | |
| 09922 | Burndy Corp. | Norwalk, Conn. |
| 10214 | General Transistor Western Corp. | Los Angeles, Cal. |
| 10411 | Ti-Tal, Inc. | Berkeley, Cal. |
| 10646 | Carborundum Co. | Niagara Falls, N.Y. |
| 11236 | CTS of Berne, Inc. | Berne, Ind. |
| 11237 | Chicago Telephone of California, Inc. | So. Pasadena, Cal. |
| 11242 | Bay State Electronics Corp. | Waltham, Mass. |
| 11312 | Teledyne Inc., Microwave Div. | Palo Alto, Cal. |
| 11314 | National Seal | Downey, Cal. |
| 11453 | Precision Connector Corp. | Jamaica, N.Y. |
| 11534 | Duncan Electronics Inc. | Costa Mesa, Cal. |
| 11711 | General Instrument Corp., Semiconductor Division Products Group | Newark, N.J. |
| 11717 | Imperial Electronic, Inc. | Buena Park, Cal. |
| 11870 | Melabs, Inc. | Palo Alto, Cal. |
| 12136 | Philadelphia Handle Co. | Camden, N.J. |
| 12361 | Grove Mfg. Co., Inc. | Shady Grove, Pa. |
| 12574 | Gulton Ind. Inc., Data System Div. | Albuquerque, N.M. |
| 12697 | Clarostat Mfg. Co. | Dover, N.H. |
| 12728 | Elmar Filter Corp | W. Haven, Conn. |
| 12859 | Nippon Electric Co., Ltd. | Tokyo, Japan |
| 12881 | Metex Electronics Corp. | Clark, N.J. |
| 12930 | Delta Semiconductor Inc. | Newport Beach, Cal. |
| 12954 | Dickson Electronics Corp. | Scottsdale, Arizona |
| 13019 | Airco Supply Co., Inc. | Witchita, Kansas |
| 13061 | Wilco Products | Detroit, Mich. |
| 13103 | Thermolloy | Dallas, Texas |
| 13327 | Solitron Devices Inc. | Tappan, N.Y. |
| 13396 | Telefunken (GmbH) | Hanover, Germany |
| 13835 | Midland-Wright Div. of Pacific Industries, Inc. | Kansas City, Kansas |
| 14099 | Sem-Tech | Newbury Park, Cal. |
| 14193 | Calif. Resistor Corp | Santa Monica, Cal. |
| 14298 | American Components, Inc. | Conshohocken, Pa. |
| 14433 | ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation | West Palm Beach, Fla. |
| 14493 | Hewlett-Packard Company | Loveland, Colo. |
| 14655 | Cornell Dublier Electric Corp | Newark, N.J. |
| 14674 | Corning Glass Works | Corning, N.Y. |
| 14752 | Electro Cube Inc. | San Gabriel, Cal. |
| 14960 | Williams Mfg. Co. | San Jose, Cal. |
| 15106 | The Sphere Co., Inc. | Little Falls, N.J. |
| 15203 | Webster Electronics Co. | New York, N.Y. |
| 15287 | Scionics Corp. | Northridge, Cal. |
| 15291 | Adjustable Bushing Co. | N. Hollywood, Cal. |
| 15558 | Micron Electronics, Garden City, Long Island, | N.Y. |
| 15566 | Amprobe Inst. Corp. | Lynbrook, N.Y. |
| 15631 | Cabletronics | Costa Mesa, Cal. |
| 15772 | Twentieth Century Coil Spring Co. | Santa Clara, Cal. |
| 15801 | Fenwal Elect. Inc. | Framingham, Mass. |
| 15818 | Amelco Inc. | Mountain View, Cal. |
| 16037 | Spruce Pine Mica Co. | Spruce Pine, N.C. |
| 16179 | Omni-Spectra Inc. | Detroit, Ill. |
| 16352 | Computer Diode Corp. | Lodi, N.J. |
| 16554 | Electroid Co. | Union, N.J. |
| 16585 | Boots Aircraft Nut Corp. | Pasadena, Cal. |
| 16688 | Ideal Prec. Meter Co., Inc., De Jur Meter Div. | Brooklyn, N.Y. |
| 16758 | Delco Radio Div. of G.M. Corp. | Kokomo, Ind. |
| 17109 | Thermonetics Inc. | Canoga Park, Cal. |
| 17474 | Tranex Company | Mountain View, Cal. |
| 17675 | Hamlin Metal Products Corp. | Akron, Ohio |
| 17745 | Angstrohm Prec. Inc. | No. Hollywood, Cal. |
| 17856 | Siliconix Inc. | Sunnyvale, Cal. |
| 17870 | McGraw-Edison Co. | Manchester, N.H. |
| 18042 | Power Design Pacific Inc. | Palo Alto, Cal. |
| 18083 | Clevite Corp. Semiconductor Div. | Palo Alto, Cal. |
| 18324 | Signetics Corp. | Sunnyvale, Cal. |
| 18476 | Ty-Car Mfg. Co., Inc. | Holliston, Mass. |
| 18486 | TRW Elect. Comp. Div. | Des Plaines, Ill. |
| 18565 | Chomerics | Plainville, Mass. |
| 18583 | Curtis Instrument, Inc. | Mt. Kisco, N.Y. |
| 18612 | Vishay Instruments Inc. | Malvern, Pa. |
| 18673 | E.I. DuPont and Co., Inc. | Wilmington, Del. |
| 18911 | Durant Mfg. Co. | Milwaukee, Wis. |
| 19315 | The Bendix Corp., Navigation & Control Div. | Teterboro, N.J. |
| 19500 | Thomas A. Edison Industries, Div. of McGraw-Edison | West Orange, N.J. |
| 19589 | Conova | Baldwin Park, Cal. |

## CODE LIST OF MANUFACTURERS (Continued)

| Code No. | Manufacturer | Address |
|---|---|---|
| 19644 | LRC Electronics | Horseheads, N.Y. |
| 19701 | Electra Mfg. Co. | Independence, Kansas |
| 20183 | General Atronics Corp. | Philadelphia, Pa. |
| 21226 | Executone, Inc. | Long Island City, N.Y. |
| 21355 | Fafnir Bearing Co., The | New Britian, Conn. |
| 21520 | Fansteel Metallurgical Corp. | N. Chicago, Ill. |
| 23020 | General Reed Co. | Metuchen, N.J. |
| 23042 | Texscan Corp. | Indianapolis, Ind. |
| 23783 | British Radio Electronics Ltd. | Washington, D.C. |
| 24455 | G.E. Lamp Division, Nela Park, | Cleveland, Ohio |
| 24655 | General Radio Co. | West Concord, Mass. |
| 24681 | Memcor Inc., Comp. Div. | Huntington, Ind. |
| 26365 | Gries Reproducer Corp. | New Rochelle, N.Y. |
| 26462 | Grobert File Co. of America, Inc. | Carlstadt, N.J. |
| 26851 | Compac Hollister Co. | Hollister, Cal. |
| 26992 | Hamilton Watch Co. | Lancaster, Pa. |
| 28480 | Hewlett-Packard Co. | Palo Alto, Cal. |
| 28520 | Heyman Mfg. Co. | Kenilworth, N.J. |
| 30817 | Instrument Specialties Co., Inc. | Little Falls, N.J. |
| 33173 | G.E. Receiving Tube Dept. | Owensboro, Ky. |
| 35434 | Lectrohm Inc. | Chicago, Ill. |
| 36196 | Stanwyck Coil Products, Ltd. | Hawkesbury, Ontario, Canada |
| 36287 | Cunningham, W.H. & Hill, Ltd. | Toronto, Ontario, Canada |
| 37942 | P.R. Mallory & Co., Inc. | Indianapolis, Ind. |
| 39543 | Mechanical Industries Prod. Co. | Akron, Ohio |
| 40920 | Miniature Precision Bearings, Inc. | Keene, N.H. |
| 40931 | Honeywell Inc. | Minneapolis, Minn. |
| 42190 | Muter Co. | Chicago, Ill. |
| 43990 | C.A. Norgren Co. | Englewood, Colo. |
| 44655 | Ohmite Mfg. Co. | Skokie, Ill. |
| 46384 | Penn Eng. & Mfg. Corp. | Doylestown, Pa. |
| 47904 | Polaroid Corp. | Cambridge, Mass. |
| 48620 | Precision Thermometer & Inst. Co. | Southampton, Pa. |
| 49956 | Microwave & Power Tube Div. | Waltham, Mass. |
| 52090 | Rowan Controller Co. | Westminster, Md. |
| 52983 | HP Co., Med. Elec. Div. | Waltham, Mass. |
| 54294 | Shallcross Mfg. Co. | Selma, N.C. |
| 55026 | Simpson Electric Co. | Chicago, Ill. |
| 55933 | Sonotone Corp. | Elmsford, N.Y. |
| 55938 | Raytheon Co. Commercial Apparatus & System Div. | So. Norwalk, Conn. |
| 56137 | Spaulding Fibre Co., Inc. | Tonawanda, N.Y. |
| 56289 | Sprague Electric Co. | North Adams, Mass. |
| 58474 | Superior Elect. Co. | Bristol, Conn. |
| 59446 | Telex Corp. | Tulsa, Okla. |
| 59730 | Thomas & Betts Co. | Elizabeth, N.J. |
| 60741 | Triplett Electrical Inst. Co. | Bluffton, Ohio |
| 61775 | Union Switch and Signal Div. of Westinghouse Air Brake Co. | Pittsburgh, Pa. |
| 62119 | Universal Electric Co. | Owosso, Mich. |
| 63743 | Ward-Leonard Electric Co. | Mt. Vernon, N.Y. |
| 64959 | Western Electric Co., Inc. | New York, N.Y. |
| 65092 | Weston Inst. Inc. Weston-Newark | Newark, N.J. |
| 66295 | Wittek Mfg. Co. | Chicago, Ill. |
| 66346 | Minnesota Mining & Mfg. Co. Revere Mincom Div. | St. Paul, Minn. |
| 70276 | Allen Mfg. Co. | Hartford, Conn. |
| 70309 | Allied Control | New York, N.Y. |
| 70318 | Allmetal Screw Product Co., Inc. | Garden City, N.Y. |
| 70417 | Amplex, Div. of Chrysler Corp. | Detroit, Mich. |
| 70485 | Atlantic India Rubber Works, Inc. | Chicago, Ill. |
| 70563 | Amperite Co., Inc. | Union City, N.J. |
| 70674 | ADC Products Inc. | Minneapolis, Minn. |
| 70903 | Belden Mfg. Co. | Chicago, Ill. |
| 70998 | Bird Electric Corp. | Cleveland, Ohio |
| 71002 | Birnbach Radio Co. | New York, N.Y. |
| 71034 | Bliley Electric Co., Inc. | Erie, Pa. |
| 71041 | Boston Gear Works Div. of Murray Co. of Texas | Quincey, Mass. |
| 71218 | Bud Radio, Inc. | Willoughby, Ohio |
| 71279 | Cambridge Thermionics Corp. | Cambridge, Mass. |
| 71286 | Camloc Fastener Corp. | Paramus, N.J. |
| 71313 | Cardwell Condenser Corp. | Lindenhurst, L.I., N.Y. |
| 71400 | Bussmann Mfg. Div. of McGraw-Edison Co. | St. Louis, Mo. |
| 71436 | Chicago Condenser Corp. | Chicago, Ill. |
| 71447 | Calif. Spring Co., Inc. | Pico-Rivera, Cal. |
| 71450 | CTS Corp. | Elkhart, Ind. |
| 71468 | ITT Cannon Electric Inc. | Los Angeles, Cal. |
| 71471 | Cinema, Div. Aerovox Corp. | Burbank, Cal. |
| 71482 | C.P. Clare & Co. | Chicago, Ill. |
| 71590 | Centralab Div. of Globe Union Inc. | Milwaukee, Wis. |
| 71616 | Commercial Plastics Co. | Chicago, Ill. |
| 71700 | Cornish Wire Co., The | New York, N.Y. |
| 71707 | Coto Coil Co., Inc. | Providence, R.I. |
| 71744 | Chicago Miniature Lamp Works | Chicago, Ill. |
| 71785 | Cinch Mfg. Co., Howard B. Jones Div. | Chicago, Ill. |
| 71984 | Dow Corning Corp. | Midland, Mich. |
| 72136 | Electro Motive Mfg. Co., Inc. | Willimantic, Conn. |
| 72619 | Dialight Corp. | Brooklyn, N.Y. |
| 72656 | Indiana General Corp., Electronics Div. | Keasby, N.J. |
| 72699 | General Instrument Corp., Cap Division | Newark, N.J. |
| 72765 | Drake Mfg. Co. | Harwood Heights, Ill. |
| 72825 | Hugh H. Eby Inc. | Philadelphia, Pa. |
| 72928 | Gudeman Co. | Chicago, Ill. |
| 72962 | Elastic Stop Nut Corp. | Union, N.J. |
| 72964 | Robert M. Hadley Co. | Los Angeles, Cal. |
| 72982 | Erie Technological Products, Inc. | Erie, Pa. |
| 73061 | Hansen Mfg. Co., Inc. | Princeton, Ind. |
| 73076 | H.M. Harper Co. | Chicago, Ill. |
| 73138 | Helipot Div. of Beckman Inst., Inc. | Fullerton, Cal. |
| 73293 | Hughes Products Division of Hughes Aircraft Co. | Newport Beach, Cal. |
| 73445 | Amperex Elect. Co. | Hicksville, L.I., N.Y. |
| 73506 | Bradley Semiconductor Corp. | New Haven, Conn. |
| 73559 | Carling Electric, Inc. | Hartford, Conn. |
| 73586 | Circle F Mfg. Co. | Trenton, N.J. |
| 73682 | George K. Garrett Co., Div. MSL Industries, Inc. | Philadelphia, Pa. |
| 73734 | Federal Screw Products, Inc. | Chicago, Ill. |
| 73743 | Fischer Special Mfg. Co. | Cincinnati, Ohio |
| 73793 | General Industries Co., The | Elyria, Ohio |
| 73846 | Goshen Stamping & Tool Co. | Goshen, Ind. |
| 73899 | JFD Electronics Corp. | Brooklyn, N.Y. |
| 73905 | Jennings Radio Mfg. Corp. | San Jose, Cal. |
| 73957 | Groove-Pin Corp. | Ridgefield, N.J. |
| 74276 | Signalite Inc. | Neptune, N.J. |
| 74455 | J.H. Winns, and Sons | Winchester, Mass. |
| 74861 | Industrial Condenser Corp. | Chicago, Ill. |
| 74868 | R.F. Products Division of Amphenol-Borg Electronic Corp. | Danbury, Conn. |
| 74970 | E.F. Johnson Co. | Waseca, Minn. |
| 75042 | International Resistance Co. | Philadelphia, Pa. |
| 75263 | Keystone Carbon Co., Inc. | St. Marys, Pa. |
| 75378 | CTS Knights, Inc. | Sandwich, Ill. |
| 75382 | Kulka Electric Corp. | Mt. Vernon, N.Y. |
| 75818 | Lenz Electric Mfg. Co. | Chicago, Ill. |
| 75915 | Littlefuse, Inc. | Des Plaines, Ill. |
| 76005 | Lord Mfg. Co. | Erie, Pa. |
| 76210 | C.W. Marwedel | San Francisco, Cal. |
| 76433 | General Instrument Corp., Micamold Division | Newark, N.J. |
| 76487 | James Millen Mfg. Co., Inc. | Malden, Mass. |
| 76493 | J.W. Miller Co. | Los Angeles, Cal. |
| 76530 | Cinch-Monadnock, Div. of United Carr Fastener Corp. | San Leandro, Cal. |
| 76545 | Mueller Electric Co. | Cleveland, Ohio |
| 76703 | National Union | Newark, N.J. |
| 76854 | Oak Manufacturing Co. | Crystal Lake, Ill. |
| 77068 | The Bendix Corp., Electrodynamics Div. | N. Hollywood, Cal. |
| 77075 | Pacific Metals Co. | San Francisco, Cal. |
| 77221 | Phaostran Instrument and Electronic Co. | So. Pasadena, Cal. |
| 77252 | Philadelphia Steel and Wire Corp. | Philadelphia, Pa. |
| 77342 | American Machine & Foundry Co. Potter & Brumfield Div. | Princeton, Ind. |
| 77630 | TRW Electronic Components Div. | Camden, N.J. |
| 77638 | General Instrument Corp., Rectifier Division | Brooklyn, N.Y. |
| 77764 | Resistance Products Co. | Harrisburg, Pa. |
| 77969 | Rubbercraft Corp. of Calif. | Torrance, Cal. |
| 78189 | Shakeproof Division of Illinois Tool Works | Elgin, Ill. |
| 78277 | Sigma | So. Braintree, Mass. |
| 78283 | Signal Indicator Corp. | New York, N.Y. |
| 78290 | Struthers-Dunn Inc. | Pitman, N.J. |
| 78452 | Thompson-Bremer & Co. | Chicago, Ill. |
| 78471 | Tilley Mfg. Co. | San Francisco, Cal. |
| 78488 | Stackpole Carbon Co. | St. Marys, Pa. |
| 78493 | Standard Thomson Corp. | Waltham, Mass. |
| 78553 | Tinnerman Products, Inc. | Cleveland, Ohio |
| 78790 | Transformer Engineers | San Gabriel, Cal. |
| 78947 | Ucinite Co. | Newtonville, Mass. |
| 79136 | Waldes Kohinoor Inc. | Long Island City, N.Y. |
| 79142 | Veeder Root, Inc. | Hartford, Conn. |
| 79251 | Wenco Mfg. Co. | Chicago, Ill. |
| 79727 | Continental-Wirt Electronics Corp. | Philadelphia, Pa. |
| 79963 | Zierick Mfg. Corp. | New Rochelle, N.Y. |
| 80031 | Mepco Division of Sessions Clock Co. | Morristown, N.J. |
| 80033 | Prestole Corp. | Toledo, Ohio |
| 80120 | Schnitzer Alloy Products Co. | Elizabeth, N.J. |
| 80131 | Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer. | |
| 80207 | Unimax Switch, Div. Maxon Electronics Corp. | Wallingford, Conn. |
| 80223 | United Transformer Corp. | New York, N.Y. |
| 80248 | Oxford Electric Corp. | Chicago, Ill. |
| 80294 | Bourns Inc. | Riverside, Cal. |
| 80411 | Arco Div. of Robertshaw Controls Co. | Columbus, Ohio |
| 80486 | All Star Products Inc. | Defiance, Ohio |
| 80509 | Avery Label Co. | Monrovia, Cal. |
| 80583 | Hammarlund Co., Inc. | Mars Hill, N.C. |
| 80640 | Stevens, Arnold, Co., Inc. | Boston, Mass. |
| 80813 | Dimco Gray Co. | Dayton, Ohio |
| 81030 | International Inst. Inc. | Orange, Conn. |
| 81073 | Grayhill Co. | LaGrange, Ill. |
| 81095 | Triad Transformer Corp. | Venice, Cal. |
| 81312 | Winchester Elec. Div. Litton Ind., Inc. | Oakville, Conn. |
| 81349 | Military Specification | |
| 81483 | International Rectifier Corp. | El Segundo, Cal. |
| 81541 | Airpax Electronics, Inc. | Cambridge, Maryland |
| 81860 | Barry Controls, Div. Barry Wright Corp. | Watertown, Mass. |
| 82042 | Carter Precision Electric Co. | Skokie, Ill. |
| 82047 | Sperti Faraday Inc., Copper Hewitt Electric Div. | Hoboken, N.J. |
| 82116 | Electric Regulator Corp. | Norwalk, Conn. |
| 82142 | Jeffers Electronics Division of Speer Carbon Co. | Du Bois, Pa. |
| 82170 | Fairchild Camera & Inst. Corp., Space & Defense Systems Div. | Paramus, N.J. |
| 82209 | Magurie Industries, Inc. | Greenwich, Conn. |
| 82219 | Sylvania Electric Prod., Inc. Electronic Tube Division | Emporium, Pa. |
| 82376 | Astron Corp. | East Newark, Harrison, N.J. |
| 82389 | Switchcraft, Inc. | Chicago, Ill. |
| 82647 | Metals & Controls Inc., Spencer Products | Attleboro, Mass. |
| 82768 | Phillips-Advance Control Co. | Joliet, Ill. |
| 82866 | Research Products Corp. | Madison, Wis. |
| 82877 | Rolton Mfg. Co., Inc. | Woodstock, N.Y. |
| 82893 | Vector Electronic Co. | Glendale, Cal. |
| 83058 | Carr Fastener Co. | Cambridge, Mass. |
| 83086 | New Hampshire Ball Bearing, Inc. | Peterborough, N.H. |
| 83125 | General Instrument Corp., Capacitor Div. | Darlington, S.C. |
| 83148 | ITT Wire and Cable Div. | Los Angeles, Cal. |
| 83186 | Victory Eng. Corp. | Springfield, N.J. |
| 83298 | Bendix Corp., Red Bank Div. | Red Bank, N.J. |
| 83315 | Hubbell Corp. | Mundelein, Ill. |
| 83324 | Rosan Inc. | Newport Beach, Cal. |
| 83330 | Smith, Herman H., Inc. | Brooklyn, N.Y. |
| 83332 | Tech Labs | Palisades Park, N.J. |
| 83385 | Central Screw Co. | Chicago, Ill. |
| 83501 | Gavitt Wire and Cable Co., Div. of Amerace Corp. | Brookfield, Mass. |
| 83594 | Burroughs Corp., Electronic Tube Div. | Plainfield, N.J. |
| 83740 | Union Carbide Corp., Consumer Prod. Div. | New York, N.Y. |
| 83777 | Model Eng. and Mfg., Inc. | Huntington, Ind. |
| 83821 | Loyd Scruggs Co. | Festus, Mo. |
| 83942 | Aeronautical Inst. & Radio Co. | Lodi, N.J. |
| 84171 | Arco Electronics Inc. | Great Neck, N.Y. |
| 84396 | A.J. Glesener Co., Inc. | San Francisco, Cal. |
| 84411 | TRW Capacitor Div. | Ogallala, Neb. |

## CODE LIST OF MANUFACTURERS (Continued)

| Code No. | Manufacturer | Address |
|---|---|---|
| 94870 | Sarkes Tarzian, Inc. | Bloomington, Ind |
| 85454 | Boonton Molding Company | Boonton, N.J. |
| 85471 | A. B. Boyd Co. | San Francisco, Cal. |
| 85474 | R. M. Bracamonte & Co. | San Francisco, Cal. |
| 85660 | Koiled Kords, Inc. | Hamden, Conn. |
| 85911 | Seamless Rubber Co. | Chicago, Ill. |
| 86174 | Fafnir Bearing Co. | Los Angeles, Calif. |
| 86197 | Clifton Precision Products Co., Inc. | Clifton Heights, Pa. |
| 86579 | Precision Rubber Products Corp. | Dayton, Ohio |
| 86684 | Radio Corp. of America, Electronic Comp. & Devices Division | Harrison, N.J. |
| 86928 | Seastrom Mfg. Co. | Glendale, Cal. |
| 87034 | Marco Industries | Anaheim, Cal. |
| 87216 | Philco Corporation (Lansdale Division) | Lansdale, Pa. |
| 87473 | Western Fibrous Glass Products Co. | San Francisco, Cal. |
| 87664 | Van Waters & Rogers Inc. | San Francisco, Cal. |
| 87930 | Tower Mfg. Corp. | Providence, R.I. |
| 88140 | Cutler-Hammer, Inc. | Lincoln, Ill |
| 88220 | Gould-National Batteries, Inc. | St. Paul, Minn. |
| 88698 | General Mills, Inc. | Buffalo, N.Y. |
| 89231 | Graybar Electric Co. | Oakland, Cal. |
| 89473 | G. E. Distributing Corp. | Schenectady, N.Y. |
| 89479 | Security Co. | Detroit, Mich. |
| 89665 | United Transformer Co. | Chicago, Ill. |
| 90030 | United Shoe Machinery Corp. | Beverly, Mass. |
| 90179 | U. S. Rubber Co., Consumer Ind. & Plastics Prod. Div. | Passaic, N.J. |
| 90365 | Belleville Speciality Tool Mfg., Inc. | Belleville, Ill. |
| 90763 | United Carr Fastener Corp. | Chicago, Ill. |
| 90970 | Bearing Engineering Co. | San Francisco, Cal. |
| 91146 | ITT Cannon Elect. Inc., Salem Div. | Salem, Mass. |
| 91260 | Connor Spring Mfg. Co. | San Francisco, Cal. |
| 91345 | Miller Dial & Nameplate Co. | El Monte, Cal. |
| 91418 | Radio Materials Co. | Chicago, Ill. |
| 91506 | Augat Inc. | Attleboro, Mass. |
| 91637 | Dale Electronics, Inc. | Columbus, Nebr. |
| 91662 | Elco Corp. | Willow Grove, Pa. |
| 91673 | Epiphone Inc. | New York, N.Y. |
| 91737 | Gremar Mfg. Co., Inc. | Wakefield, Mass. |
| 91827 | K F Development Co. | Redwood City, Cal. |
| 91886 | Malco Mfg., Inc. | Chicago, Ill. |
| 91929 | Honeywell Inc., Micro Switch Division | Freeport, Ill. |
| 91961 | Nahm-Bros. Spring Co. | Oakland, Cal. |
| 92180 | Tru-Connector Corp. | Peabody, Mass. |
| 92367 | Elgeet Optical Co., Inc. | Rochester, N.Y. |
| 92607 | Tensolite Insulated Wire Co., Inc. | Tarrytown, N.Y. |
| 92702 | IMC Magnetics Corp. | Westbury, L.I., N.Y. |
| 92966 | Hudson Lamp Co. | Kearney, N.J. |
| 93332 | Sylvania Electric Prod. Inc., Semiconductor Div. | Woburn, Mass. |
| 93369 | Robbins & Myers Inc. | Palisades Park, N.J. |
| 93410 | Stemco Controls, Div. of Essex Wire Corp. | Mansfield, Ohio |
| 93632 | Waters Mfg. Co. | Culver City, Cal. |
| 93929 | G.V. Controls | Livingston, N.J. |
| 94137 | General Cable Corp. | Bayonne, N.J. |
| 94144 | Raytheon Co., Comp. Div., Ind. Comp. Operations | Quincy, Mass. |
| 94148 | Scientific Electronics Products, Inc. | Loveland, Colo. |
| 94154 | Wagner Elect. Corp., Tung-Sol Div. | Newark, N.J. |
| 94197 | Curtiss-Wright Corp., Electronics Div. | East Patterson, N.J. |
| 94222 | South Chester Corp. | Chester, Pa. |
| 94330 | Wire Cloth Products, Inc. | Bellwood, Ill. |
| 94375 | Automatic Metal Products Co. | Brooklyn, N.Y. |
| 94682 | Worcester Pressed Aluminum Corp. | Worcester, Mass. |
| 94696 | Magnecraft Electric Co. | Chicago, Ill. |
| 95023 | George A. Philbrick Researchers, Inc. | Boston, Mass. |
| 95146 | Alco Elect. Mfg. Co. | Lawrence, Mass. |
| 95236 | Allies Products Corp. | Diania, Fla. |
| 95238 | Continental Connector Corp. | Woodside, N.Y. |
| 95263 | Leecraft Mfg. Co., Inc. | Long Island, N.Y. |
| 95265 | National Coil Co. | Sheridan, Wyo. |
| 95275 | Vitramon, Inc. | Bridgeport, Conn. |
| 95348 | Gordos Corp. | Bloomfield, N.J. |
| 95354 | Methode Mfg. Co. | Rolling Meadows, Ill. |
| 95566 | Arnold Engineering Co. | Marengo, Ill. |
| 95712 | Dage Electric Co., Inc. | Franklin, Ind. |
| 95984 | Siemon Mfg. Co. | Wayne, Ill. |
| 95987 | Weckesser Co. | Chicago, Ill. |
| 96067 | Microwave Assoc., West. Inc. | Sunnyvale, Cal. |
| 96095 | Hi-Q Div. of Aerovox Corp. | Olean, N.Y. |
| 96256 | Thordarson-Meissner Inc. | Mt. Carmel, Ill. |
| 96296 | Solar Mfg. Co. | Los Angeles, Cal. |
| 96396 | Microswitch, Div. of Minn.-Honeywell | Freeport, Ill. |
| 96330 | Carlton Screw Co. | Chicago, Ill. |
| 96341 | Microwave Associates, Inc. | Burlington, Mass. |
| 96501 | Excel Transformer Co. | Oakland, Cal. |
| 96508 | Xcelite, Inc. | Orchard Park, N.Y. |
| 96733 | San Fernando Elec. Mfg. Co. | San Fernando, Cal. |
| 96881 | Thomson Ind. Inc. | Long Island, N.Y. |
| 97464 | Industrial Retaining Ring Co. | Irvington, N.J. |
| 97539 | Automatic & Precision Mfg. | Englewood, N.J. |
| 97979 | Reon Resistor Corp. | Yonkers, N.Y. |
| 97983 | Litton System Inc., Adler-Westrex Commun. Div. | New Rochelle, N.Y. |
| 98141 | R-Tronics, Inc. | Jamaica, N.Y. |
| 98159 | Rubber Teck, Inc. | Gardena, Cal. |
| 98220 | Hewlett-Packard Co., Medical Elec. Div. | Pasadena, Cal. |
| 98278 | Microdot, Inc. | So. Pasadena, Cal. |
| 98291 | Sealectro Corp. | Mamaronech, N.Y. |
| 98376 | Zero Mfg. Co. | Burbank, Cal. |
| 98410 | Etc Inc. | Cleveland, Ohio |
| 98731 | General Mills Inc., Electronics Div. | Minneapolis, Minn. |
| 98734 | Paeco Division of Hewlett-Packard Co. | Palo Alto, Cal. |
| 98821 | North Hills Electronics, Inc. | Glen Cove, N.Y. |
| 98978 | International Electronic Research Corp. | Burbank, Cal. |
| 99109 | Columbia Technical Corp. | New York, N.Y. |
| 99313 | Varian Associates | Palo Alto, Cal |
| 99378 | Atlee Corp. | Winchester, Mass. |
| 99515 | Marshall Ind., Capacitor Div. | Monrovia, Cal. |
| 99707 | Control Switch Division, Controls Co. of America | El Segundo, Cal. |
| 99800 | Delevan Electronics Corp. | East Aurora, N.Y. |
| 99848 | Wilco Corporation | Indianapolis, Ind. |
| 99928 | Branson Corp. | Whippany, N.J. |
| 99934 | Rembrandt, Inc. | Boston, Mass. |
| 99942 | Hoffman Electronics Corp., Semiconductor Division | El Monte, Cal |
| 99957 | Technology-Instrument Corp of California | Newbury Park, Cal. |

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

| | | |
|---|---|---|
| 0000F | Malco Tool and Die | Los Angeles, Calif. |
| 0000Z | Willow Leather Products Corp. | Newark, N.J. |
| 000AB | ETA | England |
| 000BB | Precision Instrument Comp. Co. | Van Nuys, Cal. |
| 000CS | Hewlett-Packard Co., Colorado Springs Div. | Colorado Springs, Colorado |
| 000MM | Rubber Eng. & Development | Hayward, Cal. |
| 000NN | A "N" D Mfg. Co. | San Jose, Cal. |
| 000QQ | Cooltron | Oakland, Cal. |
| 000WW | California Eastern Lab | Burlington, Cal. |
| 000YY | S.K. Smith Co. | Los Angeles, Cal. |

# MANUAL BACKDATING CHANGES

Model 3575A

GAIN-PHASE METER

This manual backdating sheet makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

| Instrument Serial No. | Make Manual Changes |
|---|---|
| 1131A-00165 and below | 1-7 |
| 1131A-00230 and below | 2-7 |
| 1234A-00280 and below | 3-7 |
| 1450A-01060 and below | 4-7 |
| 1450A-01125 and below | 5-7 |
| | |

| Instrument Serial No. | Make Manual Changes |
|---|---|
| 1450A-01061 to 1450A-01505 | 6, 7 |
| 1450A-01061 to 1450A01645 | 7 |
| | |
| | |
| | |
| | |

CHANGE NO. 1

Page 6-2:

Delete A1C9** (Not assigned).
Change A1L1 to 9140-0129 L: fxd 220 μH.
Change A1R11** to 0757-0414 R: fxd flm 432 ohm 1 % 1/8 W.
Change A1R21** to 0698-4433 R: fxd flm 2260 ohm 1 % 1/8 W.

Page 6-3:

Change A1R22 to 0757-0401 R: fxd flm 100 ohm 1 % 1/8 W.
Delete A1R23** (Not assigned).
Change A1R39** to 0757-0280 R: fxd flm 1 kilohm 1 % 1/8 W.
Delete A3C1 (Not assigned).
Delete A3C10 (Not assigned).

Page 6-4:

Change A3R13 to 0757-0346 R: fxd flm 10 ohm 1 % 1/8 W.
Delete A3R23 (Not assigned).
Change A3R42 to 0698-4452 R: fxd flm 374 ohm 1 % 1/8 W.

Schematic No. 1:

Change A1R11** to 432 ohms.
Change A1R21** to 2260 ohms.
Change A1R22 to 100 ohms.
Change A1R39** to 1 K.
Delete A1C9 and A1R23**.
R39 connects to circuit ground.
Delete A3C1.
Delete A3C10 and A3R23.
R38 and R39 connect to + 2 Vdc.
Change A3R13 to 10 ohms.
Change A3R42 to 200 ohms.

** *NOTE*

*In some instruments, the following changes were made to improve performance. Check the A1 board in your instrument to determine if these changes apply.*

*A1R11 = 221 ohms (0757-0282)*
*A1R21 = 1150 ohms (0698-4469)*
*A1R39 = 249 ohms (0698-4421)*

*A1C9 (previously not assigned) connected in parallel with A1R23 (previously not assigned) as shown on Schematic No. 1.*

*A1C9 = 62 pF (0140-0205)*
*A1R23 = 750 ohms (0757-0420)*

CHANGE NO. 2

Page 5-12:

Delete Steps e and f of Paragraph 5-42.

Page 6-2:

Change A1C2 to 0121-0036, C: var cer 5.5–18 pF.
Change A1C27 to 0160-2387, C: fxd mica 1000 pF 1% 500 Vdcw.
Delete A1C28.
Change A1J2 Part No. to 1251-3134.
Delete A1L2 thru A1L5.
Add A1MP2, 1600-0248, Support: right angle connector.

Page 6-4:

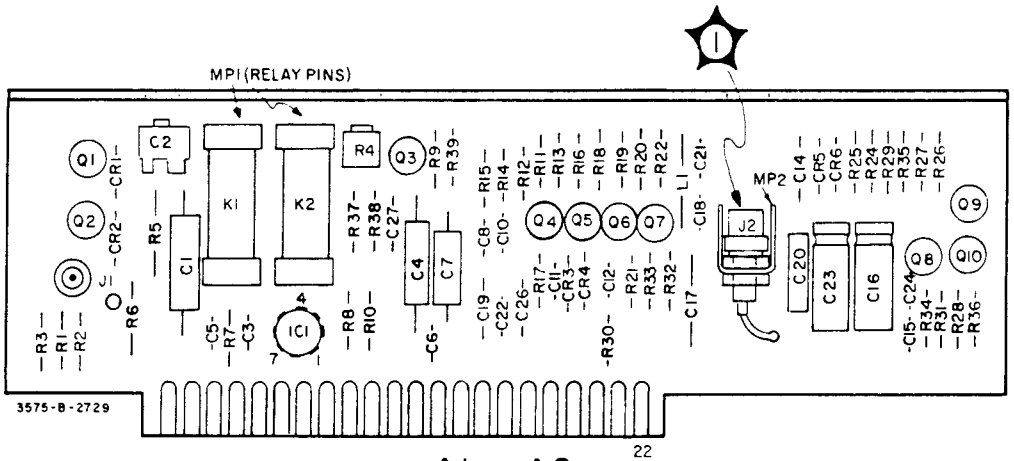
Change A1R37 to 0757-0410, R: fxd flm 301 ohm 1% 1/8W.
Delete A1R40 thru A1R43.
Change A3L1* to 9100-2232, Inductor: fxd 0.56 μH 10%.
Change A3R32 to 2100-2521, R: var flm 2000 ohm 10% lin 1/2W.
Change A3R36 to 0698-4408, R: fxd flm 124 ohm 1% 1/8W.
Change A3R37 to 0698-0082, R: fxd flm 464 ohm 1% 1/8W.
Change A3R42 to 0757-0407, R: fxd flm 200 ohm 1% 1/8W.
Change A3R50 to 2100-2516, R: var cermet 100 kilohm 10% lin 1/2W.

Page 6-18:

Change Cables W3 and W4 Part No. to 03575-61602.

Schematic No. 1:

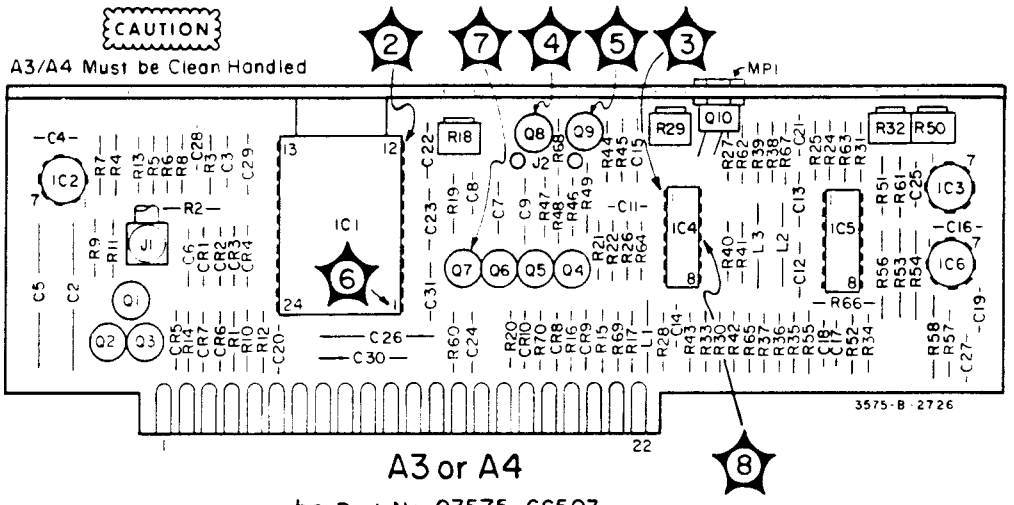
Add A1/A2 and A3/A4 Component Locators.
Delete A1/A2 L2 thru L5.
Delete A1/A2 C28.
Change A1/A2 C2 to 5.5–18 pF.
Change A1/A2 C27 to 1000 pF.
Change A1/A2 R37 to 301 ohms.
Delete A1/A2 R43 (ground C3).
Delete A1/A2 R40, R41 and R42 (ground R10).
Change voltage at junction of A1/A2 R19 and R20 to 0 V ± 10 mV.
Delete A3/A4 R71 and TP1.
Change A3/A4 R32 to 2 K.
Change A3/A4 R36 to 124 ohms.
Change A3/A4 R37 to 464 ohms.
Change A3/A4 to 200 ohms.
Change voltage at A3/A4 IC6 pins 2 and 3 to + 4.7 V.
Change voltage at A3/A4 IC5 pins 12 and 4 to + 0.55 V.
Change voltage at jumction of A3/A4 R36 and R37 to - 2.4 V.
Change voltage at junction of A3/A4 R40 and R41 to - 1 V.
Change voltage at A3/A4 IC4 pin 12 to - 2.4 V.




A1 or A2

*hp* Part No. 03575-66501

Rev C




CHANGE NO. 3

*NOTE*

*The 3575A Option 003 applies only to instruments with serial number 1241A-00281 and greater. If the serial number of your instrument is 1234A-00280 or below, disregard all references to Option 003 instruments.*

Section IV Changes:

Pages 4-11 through 4-18:

Delete Paragraphs 4-65 through 4-105 and all tables and figures contained therein.

Substitute Appendix C Paragraphs 4-65 through 4-91 and all tables and figures contained therein.

Section V Changes:

Pages 5-9, 5-10:

Delete Paragraphs 5-29 through 5-32.

Substitute Appendix C Paragraphs 5-29 through 5-32.

Page 5-17:

Change Step 1 of Figure 5-5 to read as follows:

1. To remove a Panel Meter from its dust cover, proceed as follows:

1) Unplug the Panel Meter as outlined in Step j.

2) Remove the set screws (MP42, Figure 6-2) that hold the Panel Meter in its dust cover.

3) Slide the Panel Meter out of the dust cover.

4) To troubleshoot the Panel Meter, place A12 on a 22-pin PC Extender and plug the Panel Meter into A12.

Page 5-19:

Delete Table 5-6.

Substitute Appendix C Table 5-6.

Page 5-21/5-22:

Delete Figure 5-7.

Substitute Appendix C Figure 5-7.

Page 5-25/5-26:

Delete the Digital Panel Meter Troubleshooting Tree, Figure 5-9.

Substitute the Appendix C Digital Panel Meter Troubleshooting Tree, Figure 5-9.

Section VI Changes:

Delete Pages 6-11 through 6-19.

Substitute Appendix C Pages 6-11 through 6-18.

Section VII Changes:

Page 7-1:

Delete Table 7-1.

Substitute Appendix C Table 7-1.

Delete Schematic No. 7, 9 and 10.

Substitute Appendix C Schematic No. 7, 9 and 10.

Miscellaneous Changes:

Page 6-5, Schematic No. 2:

Change A5C1 to 0150-0012, C: FXD CER 0.01 μF 20%.

Page 6-6, Schematic No. 3:

Change A6C1 to 0150-0012, C: FXD CER 0.01 μF 20%.

Delete A6R1.

Schematic No. 8:

Delete A14CR19 through CR22.

Change A14R20 to 0.24 ohm.

**3-75. Local/Remote Control.** Remote control operation is selected by applying a continuous ground (or - 0.5 V to + 0.4 V) to the Local/Remote control line (J1 pin 50). When ground is applied to the Local/Remote line, the following things take place within the 3575A:

a. The front panel controls (except LINE switch) are disabled.

b. The remote control lines are enabled.

c. The internal sampling in both panel meters is disabled (external triggering must be used).

d. The external trigger and flag timing circuits are enabled.

e. The "Remote" (RFM) annunciators on the panel meters illuminate.

**3-76. Remote Control Lines.** In the remote control mode, the 3575A Option 002 will accept parallel binary instructions applied to the remote control lines. Since internal storage is not provided, the control lines must be held at ground (or - 0.5 V to + 0.4 V) by the external controller whenever a "true" condition is required. When remote operation is selected without inputs to the remote control lines, the lines are held in a "false" condition by the internal logic circuitry. With all control lines false, the control settings are programmed as follows:

| | |
|---|---|
| AMPLITUDE B/PHASE | AMPLITUDE B |
| Voltage Range | 2 mV to 20 V (both channels) |
| FREQUENCY RANGE | 1 - 1 K |
| AMPLITUDE FUNCTION | B/A |
| PHASE REFERENCE | A |

**3-77. BCD Outputs.** The 3575A Option 002 is equipped with separate BCD outputs for the two panel meters. These outputs provide parallel BCD information that corresponds with the respective panel meter readings. The BCD outputs each consist of three 8-4-2-1 BCD-coded digits, a single-line overrange ("1") digit and a single-line polarity indicator. Unlike the remote control lines, the BCD outputs are always enabled and can be used in the local or remote control mode.

**3-78. Overload Outputs.** There are three overload indicator lines available at pins 32, 44 and 45 of the Interface connector. The $A_{ol}$ line (J1 pin 44) goes low when channel A is overloaded and the $B_{ol}$ (J1 pin 32) goes low when channel B is overloaded. The third line, labeled "overload" (J1 pin 45), goes low when either or both channels are overloaded. Since the overload outputs are not stored functions, they will automatically return to the "false" condition (+ 5 V) when the overload is removed.

**3-79. External Triggering and Flag Timing Sequence.** As previously indicated the internal sampling in both panel meters is disabled when ground is applied to the Local/Remote control line. This means that external triggering must be used to obtain successive meter readings or BCD outputs in the remote control mode.

3-80. In the 3575A Option 002, the external triggering circuit operates in conjunction with the flag timing circuit to allow adequate settling time, trigger the panel meters and provide a "data ready" flag to the external controller. The timing sequence is initiated by an external trigger pulse which is applied to the Remote Measure line (J1 pin 21). The duration of the timing sequence depends on the condition of the Trigger Mode line (J1 pin 33) which permits selection of two modes of operation: the Delayed Mode and Non-Delayed Mode.

*NOTE*

*The Remote Measure command must be delayed for at least 0.5 ms following any change that affects the programmed state of the instrument.*

**3-81. Delayed Mode.** When the Trigger Mode line is held in a "false" condition (open or + 2.4 V to + 5 V), the timing sequence is as shown in Figure 3-10. In Figure 3-10, the Remote Measure line is pulled low at T0 by the external controller. This initiates a variable delay period (determined by the Frequency Range setting) and sets the + and - Data Flags. At the end of the variable delay (T1), an 80 ms delay is initiated and, at the same time, an 80 ms trigger pulse is applied to the panel meters. At the end of the 80 ms delay (T2) both Data Flags are reset to indicate that data is ready.

3-82. The total time required to obtain a reading (T0 to T2) is equal to 80 ms plus the variable delay period determined by the Frequency Range setting. The approximate *total* delay times on each frequency range are as follows:

| Frequency Range | Total Delay |
|---|---|
| 1 - 1 K | 33 sec. |
| 10 - 100 K | 3.3 sec. |
| 100 - 1 M | 0.5 sec. |
| 1 K - 13 M | 0.1 sec. |

3-83. The purpose of the variable delay in the timing sequence is to allow time for the instrument to stabilize before a reading is taken. Since the times allotted by the variable delay are maximum, the instrument will often stabilize before the end of the delay period. This depends on the change in input parameters or control settings prior to the Remote/Measure pulse. In some applications such as swept measurements where readings are taken after slight changes in input parameters, it may be desirable to speed up the measurement process by omitting the variable time delay. This can be accomplished by holding the Trigger

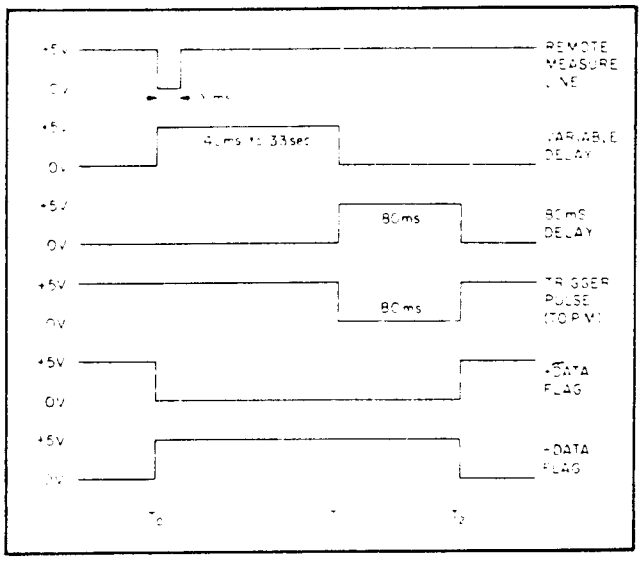



Figure 3-10. Flag Timing Delayed Mode.

Mode line in a "true" condition (gnd. or -0.5 V to +0.4 V). When the Trigger Mode line is grounded, the timing sequence is in the Non-Delayed Mode which operates as shown in Figure 3-11.

**3-84. Non-Delayed Mode.** In Figure 3-11, the Remote Measure line is pulled low at T0 by the external controller. This immediately initiates the 80 ms delay, triggers the panel meters and sets the + and - Data Flags. At the end of the 80 ms delay (T1), the Data Flags are reset to indicate that a reading has been taken.

**3-85. Remote Measure Rate.** As indicated in preceeding paragraphs, the time required to obtain a reading depends on the selected mode of operation. In the Delayed Mode, the time varies from 0.1 second to 33 seconds as a function of the Frequency Range setting. In the Non-Delayed Mode, the time is fixed at approximately 80 ms. In order to obtain sucessive readings at a fixed rate, the time between Remote Measure pulses must be greater than the total delay period. For example, in the Non-Delayed Mode the 80 ms delay period allows a maximum of 12 readings per second. In the

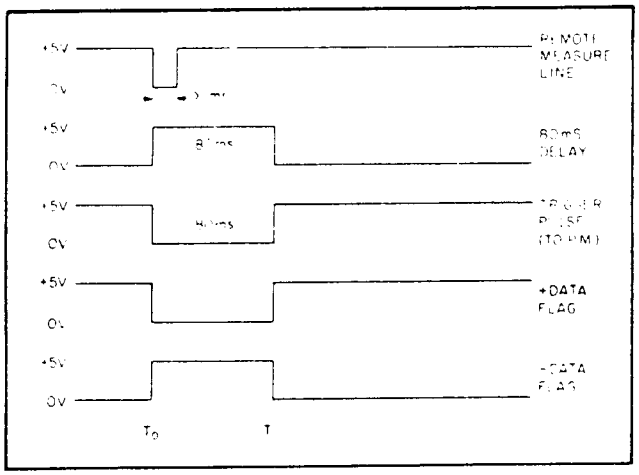



Figure 3-11. Flag Timing Non-Delayed Mode.

Delayed Mode, 0.1 sec. allows 10 readings per second, 0.5 sec allows 2 readings per second, 3.3 sec. allows 18 readings per minute and 33 seconds allows 1.8 reading per minute. In all cases, the Remote Measure pulse width must be greater than 1 ms and less than the total delay period.

**3-86. Optional Control Scheme.** For some applications, it is convenient to control the instrument from the front panel and, at the same time, use external triggering and the flag timing functions. To allow this, a jumper is provided on the Interface Assembly (A10B, Schematic No. 9). With the jumper connected between points 1 and 2 (normal), grounding the Local/Remote control line disables the front panel controls, enables the remote control lines and enables the external trigger and flag timing circuits. With the jumper connected between points 1 and 3, the front panel controls are enabled and the remote control lines are disabled regardless of the condition of the Local/Remote control line. The external triggering and flag timing functions can then be used along with the front panel controls by grounding the Local/Remote control line.

## 3-87. USING A PRINTER.

3-88. The 3575A Option 002 output lines are compatible with -hp- Digital Recorder Models 5050B and 5055A. These printers can be connected directly to the 3575A Interface connector using the -hp- 562A-16C printer cable. Complete interfacing data is presented in Section II, Paragraph 2-29.

### 3-89. Triggering.

3-90. When using a printer, it is necessary to supply a ground-true (>1 ms) Remote Measure command to the 3575A each time a printout is required (see Paragraphs 2-30 and 3-80). The Remote Measure command sets the Data Flags and initiates the timing cycle within the 3575A. The printer receives a "print" command when the Data Flags are reset at the end of the timing cycle. Unless special arrangements have been made to ground the Trigger Mode line, the 3575A will remain in the Delayed mode and the "print" command will be transmitted at the end of the delay period. The delay period varies from approximately 33 seconds to 0.1 second as a function of the Frequency Range setting. If the Trigger Mode line is grounded, the "print" command will be transmitted approximately 80 ms after the leading edge of the Remote Measure pulse.

### 3-91. Printout.

3-92. The -hp- Models 5050B and 5055A Digital Recorders provide a ten-column printout. The printer columns are numbered from right to left and the 3575A output data is printed as follows:

**4-65. Annunciator Logic (A8IC4 through IC6).** The fourth section of the Function Switching Assembly is the annunciator logic circuitry, A8IC4 through IC6. This circuit receives inputs from the $A_F$, $B_F$ and $C_F$ control lines and two additional inputs from the overload detectors on the Preamplifier Assemblies, A1 and A2. The purpose of the annunciator logic is to control the overload indicators and the various function indicators that appear on the Panel Meter display.

## 4-66. Output Filter (A9/A10 Schematic No. 6).

4-67. The Output Filter is a 4-pole low pass filter network controlled by the front panel FREQUENCY RANGE switch. The purpose of the filter is to integrate the amplitude or phase information before it is applied to the Panel Meter and ANALOG OUTPUT. The filter response is controlled by three lines, F, M and S which come from the Phase Control Filter, A7. The Output Filter network is identical to the Phase Control Filter network which is discussed in Paragraph 4-34.

4-68. It should be noted that the standard Model 3575A which has a single panel meter requires only one Output Filter. This filter is designated A9. Instruments that are equipped with dual panel meters (Options 001, 002) require a separate Output Filter for each panel meter and, therefore, contain both A9 and A10 which are identical. Since the dual panel meter options are field installable, the standard Model 3575A has a vacant board slot and connector to permit the addition of A10.

## 4-69. Digital Panel Meter.

4-70. Refer to the Panel Meter Block Diagram (Figure 4-12) and Schematic No. 7 for the following discussion.

4-71. The Digital Panel Meter is a self-contained dc digital voltmeter which measures voltages within the range of - 1.999 Vdc to + 1.999 Vdc. The Panel Meter reading in dBV, dB or degrees corresponds with the applied dc voltage. For example, an indication of - 180.0 degrees = -1.800 Vdc, - 20.0 dBV = - 200 mVdc, etc.

4-72. The Panel Meter is divided into three sections: the Analog section (A21), the Control Logic section (A20B) and the Display section (A22). The Analog section serves as a voltage to period converter where the period of the output signal is proportional to the dc input voltage. The Control Logic section converts the signal from the Analog section to bit-parallel, word-serial BCD-coded information. This digital information, which is sychronized by scanning signals from the Display section, is applied to the Display section which provides a 4-digit reading of the data.

**4-73. Analog Section.** The Analog section uses a dual-slope integrator to perform the voltage to period conversion. When a measurement is initiated by the Switch Drive signal from the Control Logic section, the integrator charges toward the input voltage for 1/60 second as shown in Figure 4-13. The integrator is then discharged at a fixed rate toward a reference voltage. Since the discharge rate is constant, the discharge time is proportional to the dc input voltage.

4-74. The output of the Analog section is low during the time the integrator is charging and discharging. When the integrator discharges to zero volts, the output of the Analog section goes high. Because this output is zero sensitive, it is called "Zero Detect".

4-75. The Zero Detect output is unaffected by the polarity of the input voltage. Input polarity is sensed in the Analog

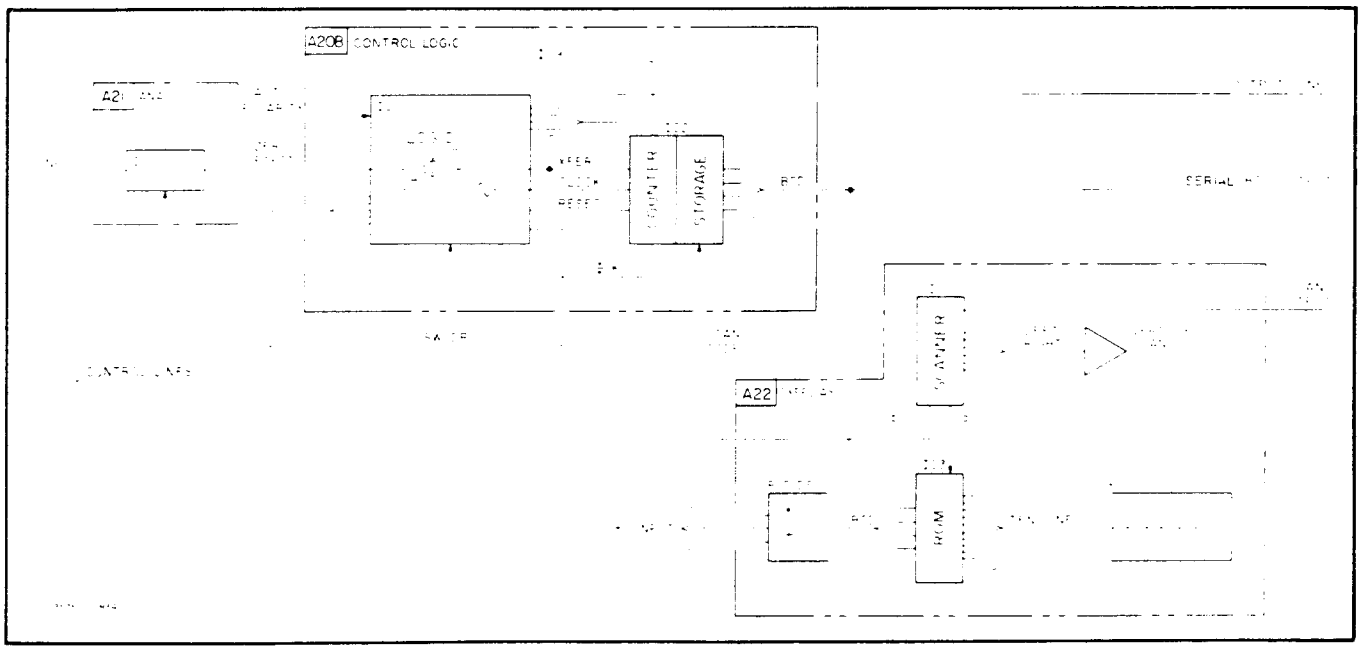



Figure 4-12. Panel Meter Block Diagram.

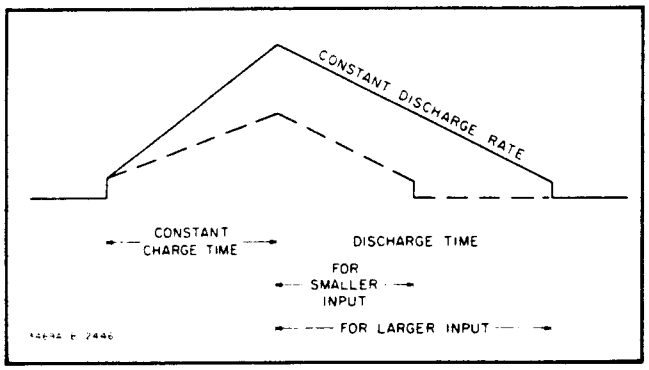



**Figure 4-13. Dual-Slope Integration.**

section and transferred (Auto Polarity line) by way of the Control Logic section to the output connector.

**4-76. Control Logic.** The Control Logic Assembly is divided into two sections: the Logic section (IC1) and the Counter Storage section (IC2). To begin a measurement, the sample rate circuit (in the Logic section) generates a Reset pulse which resets the Counter to zero. The trailing edge of the Reset pulse makes the Switch Drive signal go negative causing the integrator in the Analog section to begin charging. Following the Reset pulse, the Counter accumulates 1000 Clock pulses (1/60 second) and then causes another Reset pulse to be generated. This Reset pulse resets the Counter to zero and also turns off the Switch Drive signal causing the integrator to begin discharging. During the discharge time, the Clock continues to increment the Counter until the Analog section signals a Zero Detect. The Zero Detect signal triggers a "Transfer" pulse which transfers the accumulated count into Storage. This also places the polarity information in Storage. Due to the Clock frequency and the fixed discharge rate of the integrator, the number transferred to Storage is equal to the absolute value of the dc input voltage.

4-77. The Counter portion of the Counter Storage section is comprised of three decade counters that accumulate the number of Clock pulses between the trailing edge of one Reset pulse and the leading edge of the next. The "Transfer" pulse at the end of a measurement transfers the 1-2-4-8 BCD information contained in the Counter into the Storage buffers. The "b" and "c" scan signals from the Scanner (in the Display section) cause the BCD information to be transferred to the output lines in bit-parallel, word-serial form beginning with the least significant (right hand) digit.

**4-78. Display Section.** The Display section is divided into three parts: the Scanner (IC2), the Read Only Memory (ROM - IC3) and the display (DS1). In the Scanner, the "a", "b" and "c" scan signals are produced by three binary stages driven by a 10 kHz oscillator. The scanning signals are used to control six transistors (Q1 through Q6) through which positive voltage is sequentially applied to the three-digit display. The three digits are scanned, one-half digit at a time, beginning at the right. All three digits are scanned in approximately 0.65 milliseconds, and scanning is continuous. The "a" scan signal is also applied to the Read Only Memory to ensure that the information is read at the proper time for the right and left half of each digit. The "b" and "c" scan signals are applied to the Storage section to synchronize the output data.

4-79. The Read Only Memory accepts BCD information from the Storage section and translates the information into a ten-line code. This ten-line coded output is synchronized by the right-left ("a") scan to provide a ground connection to the proper light emitting diodes in the Display element.

## 4-80. Interface Assembly (A16B Schematic No. 9).

4-81. The Interface Assembly (A16B) is installed in place of the Interface Substitution Assembly (A16A) in instruments that are equipped with the remote programming and dual panel meter option (Option 002). The purpose of the Interface Assembly is to provide the decoding, timing and switching logic required for the BCD outputs and remote controlled functions.

**4-82. BCD Output Circuits.** The BCD output circuitry shown on the left hand side of Schematic No. 9 (IC1 through IC12) receives bit-parallel, word-serial data from the two panel meters and converts this data into bit-parallel, word-parallel BCD outputs that are available at the rear panel Interface connector. The circuitry in the upper left portion of the schematic (IC1 through IC7) converts the data from the phase panel meter while the circuitry in the lower left portion of the schematic (IC8 through IC12) converts the data from the amplitude panel meter. Since the two BCD output sections are identical, the following discussion applies to both sections.

4-83. Figure 4-14 illustrates the scanned digital information as it appears at the output of the phase panel meter. In Figure 4-14, the output data corresponds with a phase reading of +134.8 degrees. The first digit, a one, is indicated by a grounded "1" line. The three remaining digits are scanned from right to left (8, 4, 3) and are synchronized by the two scanning signals, "b" scan and "c" scan. The scanning signals indicate which digit is being

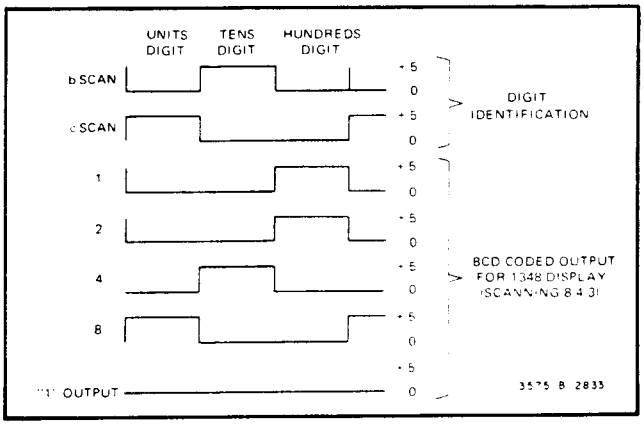



**Figure 4-14. Scanned Panel Meter Output.**

transmitted at a given time. The polarity sign (+) is indicated by a grounded "±" line and the decimal point, which remains fixed, is not supplied.

4-84. The "1" line and the "±" line from the panel meter are applied to A16B pins 7 and 8, buffered by IC1D and IC1E and applied to pins 7 and 8 of the Interface connector. The four BCD coded outputs from the panel meter are applied to A16B pins 3 through 6, inverted and applied directly to A16B IC4, IC5 and IC7. Integrated circuits IC4, 5 and 7 are 4-bit bistable latches which are enabled individually as the corresponding ("units", "tens" or "hundreds") data character is transmitted. The "enable" commands are applied to pins 4 and 13 of the IC packages by means of IC2 and IC3 which are controlled by the scanning signals from the panel meter.

4-85. Referring to Figure 4-14, note that the "units" digit (8) is transmitted when "b" scan is low and "c" scan is high. This condition is detected by the logic circuits (IC2, IC3) which enable IC7 and disable IC4 and IC5. The BCD data being transmitted is then stored in IC7 and applied to pins 1, 2, 26 and 27 of the Interface connector. As the scanning sequence continues, the "tens" digit (4) is stored in IC5 and the "hundreds" digit (3) is stored in IC4. The resulting outputs at the Interface connector are three BCD coded digits, a single line overrange ("1") digit and a polarity sign.

**4-86. Controller Section.** The controller section of the Interface Assembly is located in the upper right portion of Schematic No. 9. This section is comprised of two 4-bit multiplexers (IC13 and IC14) and a Local/Remote control circuit (IC1C, IC17B). Each multiplexer has eight inputs and four outputs. Four of the inputs to each multiplexer come from the front panel controls and four come from the rear panel Interface connector, J1. The output lines go to the Function Switching Assembly (A8), the Phase Control Filter (A7), the Log Converter (A3/A4) and the Input Attenuators (A1/A2) to control the instrument functions. The multiplexers operate like 4-pole, double-throw switches where the four output lines are connected to either the front panel controls (Local) or the remote control lines (Remote). Switching is accomplished by applying a logical "1" (+ 5 V) or "0" (0 V) to IC13, IC14 pin 9 which connects to the Local/Remote line through NAND gate IC17B. With no input to the Local/Remote line or when local control is programmed by an external controller, the line is held positive causing the output of IC17B to go low. This disables the remote inputs to IC13 and IC14 and enables the inputs from the front panel controls. When ground is applied to the Local/Remote line, the output of IC17B goes high and control is transferred to the remote control lines. The eight remote control lines use ground true logic and are normally held in a "0" (False) condition by the pull-up resistors within R5.

4-87. Note that the Local Remote line which connects to IC17B is also connected to a buffer stage, IC1C. When ground is applied to the Local Remote line (Remote Control), the output of IC1C goes low supplying a "hold" to the panel meters. In the panel meters, the "hold" command disables the internal sampling and thereby inhibits measurements. In order to obtain meter readings or BCD outputs, it is then necessary to use external triggering. External triggering is accomplished by grounding the Remote/Measure line (J1 pin 21) which controls the timing circuits discussed in the following paragraphs. In some cases, it is desirable to use external triggering and, at the same time, control the instrument from the front panel. To accomplish this, a jumper is provided at the output of IC17B. When the jumper is connected between terminals 1 and 3 (gnd), the front panel controls remain operative and the remote lines that control front panel functions are disabled.

**4-88. Timing Circuits.** In the Remote Control mode, it is necessary to trigger the panel meters by applying a momentary ground to the Remote Measure line each time a meter reading or BCD output is required. Grounding the Remote Measure line sets the data flag and initiates a variable time delay which, in turn, triggers the panel meters and resets the data flag.

4-89. The external trigger and flag timing circuit is shown in the lower right hand portion of Schematic No. 9 and in the Timing Circuits Functional Block Diagram, Figure 4-15. Refer to Figure 4-15 for the following discussion.

4-90. The timing circuits are comprised of a Trigger Flip Flop, A Flag Flip Flop, a Variable Delay, an 80 ms Delay and associated logic circuitry. Before the timing circuits can operate, remote operation must be selected by grounding the Local/Remote line. This disables the internal sampling in the panel meters and enables the timing circuits. With the Local/Remote line grounded, it is further necessary to momentarily ground the Remote Measure line to initiate the timing sequence and trigger the panel meters. Grounding the Remote Measure line causes the output of IC16A to go high. This, in turn, initiates the Variable Time Delay and sets the Flag Flip Flop. Note that the two flip flops are set and reset by a low (0) rather than a high (1). This is the reason for the inverter between the output of IC16A and the "set" side of the Flag Flip Flop. When a "set" command is applied to the Flag Flip Flop, the + Data Flag line goes low and the - Data Flag line goes high. Since the + Flag line ($\overline{Q}$) is fed back to the input of IC16A, the output of IC16A remains high until the Flag Flip Flop is reset. The Variable Delay is initiated by a Logical 1 at the output of IC16A and controlled by the two frequency range lines, FR1 and FR2. Delay time is determined by the frequency range setting as indicated in Table 4-5. At the end of the delay period, the output of the Variable Delay circuit goes low applying a "set" command to the Trigger Flip Flop. When "set", the $\overline{Q}$ side of the Trigger Flip Flop goes low to trigger the panel meters and the Q side goes high to initiate the 80 ms delay. When the 80 ms delay has elapsed, the output of the delay circuit goes low applying a "reset" command to both flip flops. This causes the Panel Meter Trigger line to go high, the + Flag line to go high and the - Flag line to go low. Resetting the flags indicates to an external controller that data is ready at the BCD outputs.

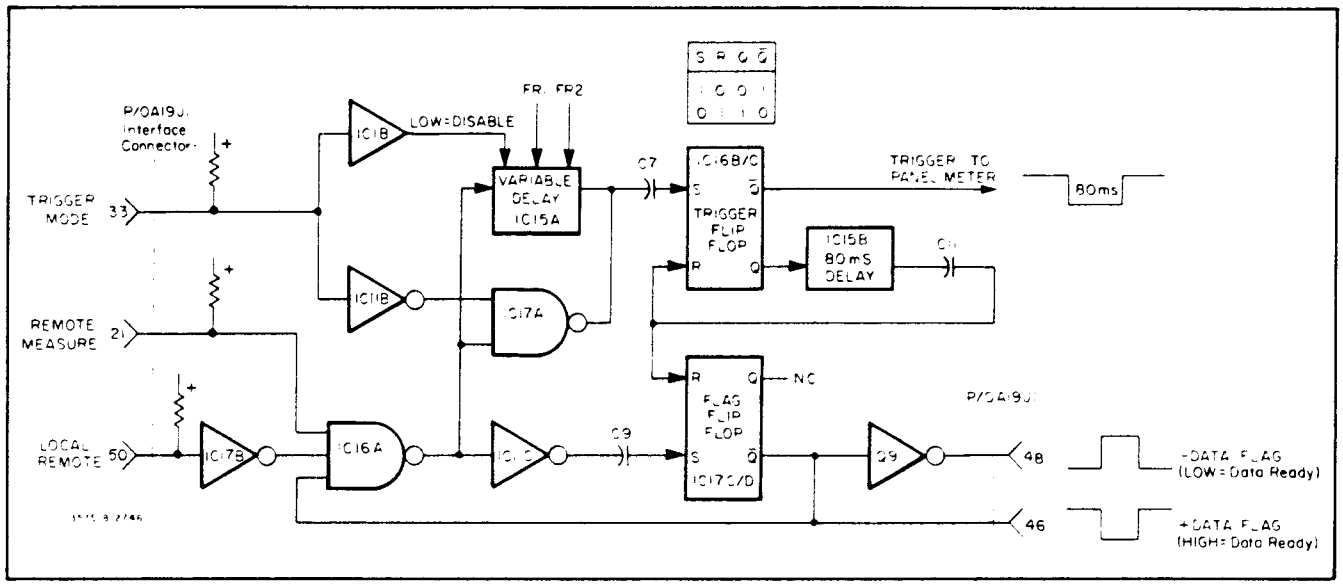



**Figure 4-15. Timing Circuits Functional Block Diagram.**

4-91. The purpose of the Variable Delay in the timing circuit is to ensure that the instrument has been given sufficient settling time before the data flags are returned.

**Table 4-5. Variable Time Delays.**

| Frequency Range | Variable Delay |
|---|---|
| 1 Hz - 1 kHz | 33 sec. |
| 10 Hz - 100 kHz | 3.3 sec. |
| 100 Hz - 1 MHz | 0.42 sec. |
| 1 kHz - 13 MHz | 0.02 sec. |

The 80 ms Delay determines the width of the trigger pulse applied to the panel meters. Since the actual settling time of the instrument is often less than the time provided by the Variable Delay circuit, the user may find it convenient to bypass the Variable Delay leaving only the 80 ms Delay. This can be accomplished by applying a continuous ground to the Trigger Mode line. Grounding the Trigger Mode line disables the Variable Delay circuit and enables IC17A. When a momentary ground is applied to the Remote Measure line, the output of IC16A goes high, the output of IC17A goes low and the two flip flops are set simultaneously. At the end of the 80 ms delay, both flip flops are reset, the Trigger line goes high and the data flags are returned to their original states.

## 5-29. Panel Meter Adjustments (Standard Model 3575A).

*NOTE*

*Options 001, 002: Refer to Paragraph 5-31*

5-30. The purpose of these adjustments is to set the dc accuracy of the Digital Panel Meter. Before proceeding with these adjustments, perform the Panel Meter Accuracy Check (Paragraph 5-9) to determine if adjustments are necessary.

RECOMMENDED TEST EQUIPMENT:

DC Voltmeter (-hp- Model 412A)
DC Digital Voltmeter (-hp- Model 3450A)
Time Interval Counter (-hp- Model 5245L with 5267A Plug-In)*

* See note following Step e.

a. Perform Steps a through i of the Panel Meter Removal procedure (Figure 5-5) to gain access to the panel meter adjustments.

b. Set the 3575A controls as follows:

DISPLAY ..... PHASE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE ..... 10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Set A5S1 and A6S1 to CAL 1. Connect DC Voltmeter to ANALOG OUTPUT 1.

d. Connect a short clip lead between A9TP1 and A9TP2 (see Figure 5-6).

e. Adjust A9R27 for 0 V ± 0.05 mVdc at Analog Output 1.

*NOTE*

*Steps f through k are the steps required to perform the Clock Rate adjustment (A21R6). It is not necessary to perform the Clock Rate adjustment unless the panel meter is malfunctioning or has just been repaired. If the Clock Rate adjustment is required, perform Steps f through k; if not, proceed to Step l.*

f. Set the 3575A LINE switch to OFF. Unplug the panel meter and remove it from its dust cover as outlined in Figure 5-5, Steps k and l.

g. Place the A12 Assembly on a 22-pin PC Extender and plug the panel meter into A12. Set the 3575A LINE switch to ON.

h. Set the Time Interval Counter to measure a 16.67 ms, 10 V p-p (± 5 V) pulse. Set the Start Channel to trigger on the - slope and the Stop Channel to trigger on the + slope. Set the Trigger Level controls to Preset.

i. Connect both inputs of the Time Interval Counter to A20ATP1 (marked "S").

j. Adjust A21R6 for a time interval reading of 16.67 ms.

k. Set the 3575A LINE switch to OFF. Reinstall the panel meter in its dust cover, replace A12 and install the panel meter in its normal position. Set the 3575A LINE switch to ON.

l. Connect DC Voltmeter to A21TP1 (See Figure 5-7).

m. Adjust A21R1 for 0 V ± 0.5 mVdc at TP1.

n. Reconnect DC Voltmeter to ANALOG OUTPUT 1.

o. Adjust A21R2 until the polarity sign alternates between + and - .

p. Adjust A9R27 for + 0.5 mVdc at Analog Output 1.

q. Adjust A21R5 until the last digit of the display alternates between 1 and 0.

r. Readjust A9R27 for 0 V ± 0.05 mVdc at Analog Output 1.

s. Connect DC Digital Voltmeter to Analog Output 1.

t. Remove clip lead from between A9TP1 and A9TP2.

u. Set A6S1 to CAL 2.

v. Adjust A6R19 (Y ADJ) for a reading of + 1.800 Vdc at Analog Output 1.

w. Adjust A21R3 for a panel meter reading of + 180.0 degrees.

x. This completes the panel meter adjustments. Reset A5S1 and A6S1 to NORMAL (4) and reassemble the instrument by reversing the procedure outlined in Figure 5-5. Perform the Output Filter Zero Adjustments (Paragraph 5-33), the Phase Detector Zero Adjustments (Paragraph 5-35) and the Current Source and Current Sink Adjustments (Paragraph 5-37) before using the 3575A in a phase measurement application.

## 5-31. Panel Meter Adjustments (Options 001, 002).

5-32. The purpose of these adjustments is to set the dc accuracy of the panel meters. Before proceeding with these adjustments, perform the Panel Meter Accuracy Check (Paragraph 5-9) to determine if adjustments are necessary.

RECOMMENDED TEST EQUIPMENT:

DC Voltmeter (-hp- Model 412A)
DC Digital Voltmeter (-hp- Model 3450A)
Time Interval Counter (-hp- Model 5245L with 5267A Plug-In)*

* See note following Step e.

*NOTE*

*The following procedure outlines the steps required to adjust the right-hand (phase) panel meter. When the adjustments for the right-hand panel meter are completed, place the left-hand panel meter in the right-hand slot and repeat the procedure.*

a. Perform Steps a through i of the Panel Meter Removal procedure (Figure 5-5) to gain access to the panel meter adjustments.

b. Set the 3575A controls as follows:

AMPLITUDE B/PHASE .....PHASE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .....10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Set A5S1 and A6S1 to CAL 1. Connect DC Voltmeter to ANALOG OUTPUT 2.

d. Connect a short clip lead between A10TP1 and A10TP2 (see Figure 5-6).

e. Adjust A10R27 for 0 V ± 0.05 mVdc at Analog Output 2.

*NOTE*

*Steps f through k are the steps required to perform the Clock Rate adjustment (A21/A24R6). It is not necessary to perform the Clock Rate adjustment unless the panel meter is malfunctioning or has just been repaired. If the Clock Rate adjustment is required, perform Steps f through k; if not, proceed to Step l.*

f. Set the 3575A LINE switch to OFF. Unplug both panel meters and remove the panel meter to be adjusted from its dust cover as outlined in Figure 5-5, Steps k and l.

g. Place the A12 Assembly on a 22-pin PC Extender and plug the panel meter to be adjusted into A12J2 (right-hand connector). Set the 3575A LINE switch to ON.

h. Set the Time Interval Counter to measure a 16.67 ms, 10 V p-p (± 5 V) pulse. Set the Start Channel to trigger on the - slope and the Stop Channel to trigger on the + slope. Set the Trigger Level controls to Preset.

i. Connect both inputs of the Time Interval Counter to A23ATP1 (marked "S").

j. Adjust A24R6 for a time interval reading of 16.67 ms.

k. Set the 3575A LINE switch to OFF. Reinstall the panel meter in its dust cover, replace A12 and install the panel meter in the right-hand slot. Set the 3575A LINE switch to ON.

l. Connect DC Voltmeter to A23TP1 (see Figure 5-7).

m. Adjust A23R1 for 0 V ± 0.5 mVdc at TP1.

n. Reconnect DC Voltmeter to ANALOG OUTPUT 2.

o. Adjust A24R2 until the polarity sign alternates between + and - .

p. Adjust A10R27 for + 0.5 mVdc at Analog Output 2.

q. Adjust A24R5 until the last digit of the display alternates between 1 and 0.

r. Readjust A10R27 for 0 V ± 0.05 mVdc at Analog Output 2.

s. Connect DC Digital Voltmeter to Analog Output 2.

t. Remove clip lead from between A10TP1 and A10TP2.

u. Set A6S1 to CAL 2.

v. Adjust A6R19 (Y ADJ) for a reading of + 1.800 Vdc at Analog Output 2.

w. Adjust A24R3 for a panel meter reading of + 180.0 degrees.

x. Place the left-hand panel meter in the right-hand slot and repeat Steps c through w. When adjustments are completed for both panel meters, reset A5S1 and A6S1 to NORMAL (4), install the panel meters in their original slots and reassemble the instrument by reversing the procedure outlines in Figure 5-5. Perform the Output Filter Zero Adjustments (Paragraph 5-33), the Phase Detector Zero Adjustment (Paragraph 5-35) and the Current Source and Current Sink Adjustments (Paragraph 5-37) before using the 3575A in a phase measurement application.

Table 5-6. Power Supply Ratings.

| Power Supply | Test Point | Voltage Limit | Ripple (p-p) | Line Regulation (115 V/230 V ± 10 %) | Nominal Load Current |
|---|---|---|---|---|---|
| + 12 V * | A7P1 Pin 6 | + 11.997 V to + 12.003 V | 1 mV | ± 1 mV | 180 mA |
| - 12 V | A7P1 Pin F | - 11.960 V to - 12.040 V | 1 mV | ± 1 mV | 180 mA |
| - 6 V (A) | A7P1 Pin D | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| - 6 V (B) | A7P1 Pin 4 | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| + 5 V | A7P1 Pin 21 | + 4.980 V to + 5.020 V | 1 mV | ± 0.1 mV | 500 mA ** |
| - 5.3 V | A7P1 Pin Y | - 5.200 V to - 5.400 V | 1 mV | ± 0.1 mV | 350 mA |
| + 3.8 V | A7P1 Pin 3 | + 3.700 V to + 3.900 V | 3 mV | ± 0.2 mV | 600 mA † |

* Adjustable (A14R6) ** Load increases to 1.0 A in Option 002 instruments.

† Load increases to 750 mA in Option 001 instruments and 800 mA in Option 002 instruments.

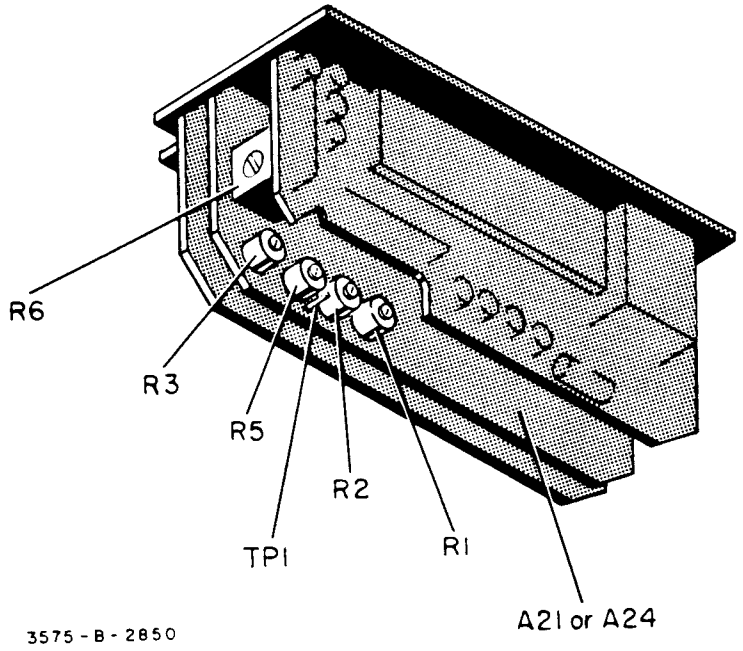
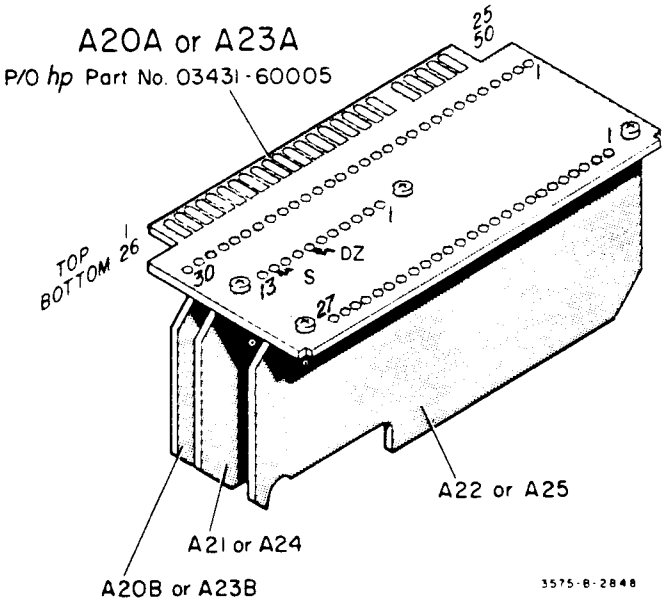



Figure 5-7. Location of Panel Meter Adjustments.




**DIGITAL PANEL METER CONNECTIONS (A12 J1 OR J2)**

| TOP (CIRCUIT SIDE) | | BOTTOM (COMPONENT SIDE) | |
|---|---|---|---|
| PIN | | PIN | |
| 1 | | 26 | |
| 2 | | 27 | |
| 3 | | 28 | ‡ |
| 4 | | 29 | OVERLOAD |
| 5 | HOLD | 30 | |
| 6 | "1" OVERRANGE | 31 | |
| 7 | EXT. TRIGGER | 32 | |
| 8 | + 5 V | 33 | |
| 9 | + 5 V | 34 | |
| 10 | - 5.3 V | 35 | |
| 11 | - 10 V | 36 | |
| 12 | | 37 | |
| 13 | + 3.8 V | 38 | |
| 14 | "1" | 39 | $A_{OL}$ |
| 15 | "2" | 40 | "B/A" & "dB" ANNUNCIATOR CONTROL |
| 16 | "4" | 41 | |
| 17 | "8" | 42 | $B_{OL}$ |
| 18 | "b" SCAN | 43 | "A" ANNUNCIATOR CONTROL |
| 19 | "c" SCAN | 44 | HOLD |
| 20 | | 45 | |
| 21 | GND | 46 | |
| 22 | | 47 | |
| 23 | GND | 48 | "DEG" ANNUNCIATOR CONTROL |
| 24 | - 12 V | 49 | "dBV" ANNUNCIATOR CONTROL |
| 25 | + 12 V | 50 | "B" ANNUNCIATOR CONTROL |

**MEASUREMENT CONDITIONS:**

1) NO SIGNAL INPUTS APPLIED.
2) A5S1 AND A6S1 SET TO CAL 1.
3) DISPLAY: PHASE
4) AMPLITUDE FUNCTION: B/A
5) CLIP LEAD CONNECTED BETWEEN A9TP1 AND A9TP2 (LEFT-HAND PANEL METER) OR BETWEEN A10TP1 AND A10TP2 (RIGHT-HAND PANEL METER).

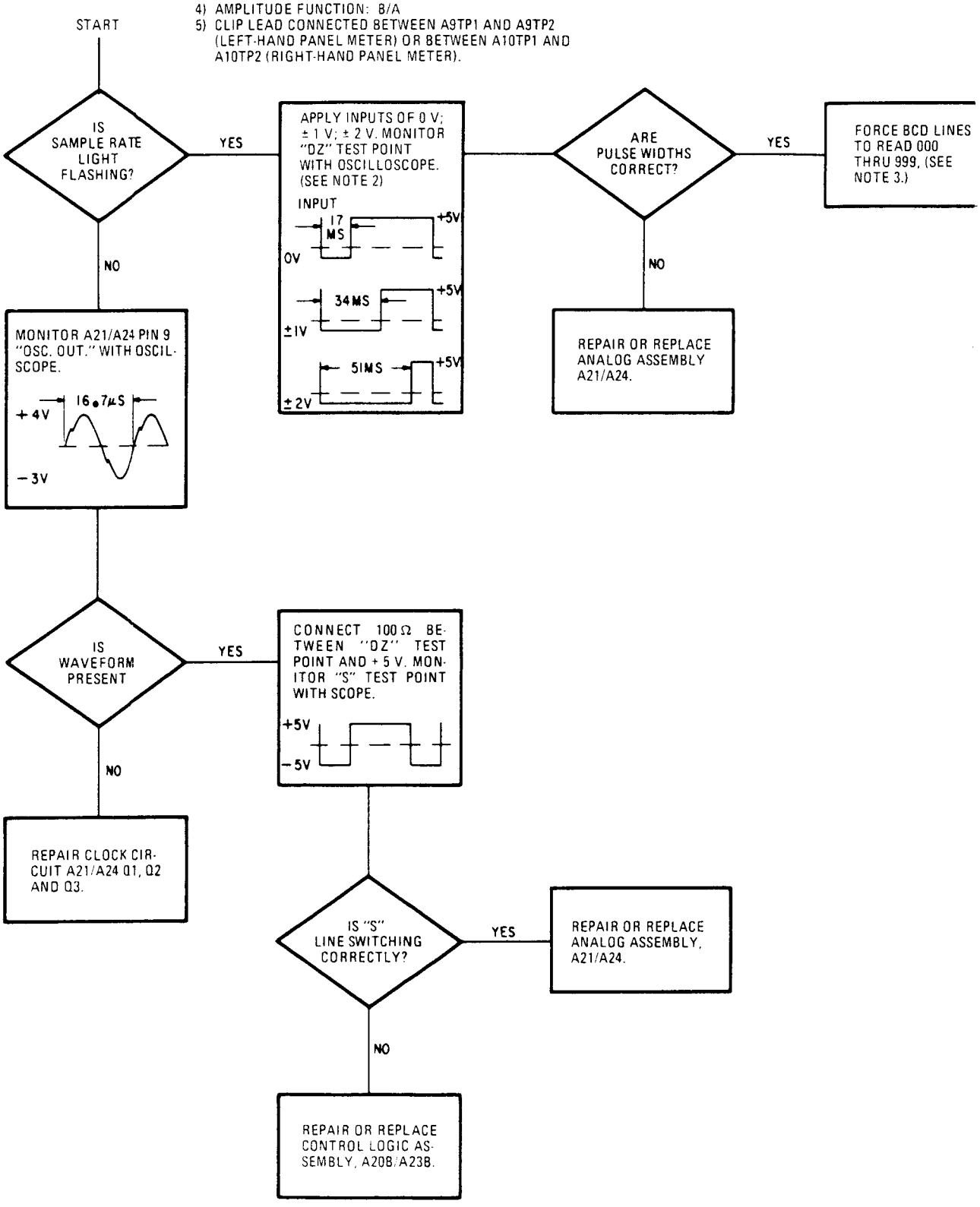


Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A11MP1 | 4040-0749 | 5 | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A11Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A11Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A11R1 | C684-2221 | | R:FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| A11R2 | 0684-2251 | 1 | R:FXD COMP 2.2 MEGOHM 10% 1/4W | 01121 | CB 2251 |
| A11R3 | | | NOT ASSIGNED | | |
| A11R4 | C698-3516 | | R:FXD FLM 6340 OHM 1% 1/8W | 28480 | 0698-3516 |
| A11R5 | 0698-3496 | 1 | R:FXD FLM 3.57K OHM 1% 1/8W | 28480 | 0698-3496 |
| A11R6 | 0757-0470 | 1 | R:FXD MET FLM 162K OHM 1% 1/8W | 28480 | 0757-0470 |
| A11R7 | 0684-5621 | 17 | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R8 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R9 | 0698-3264 | | R:FXD FLM 11.8K OHM 1% 1/8W | 28480 | 0698-3264 |
| A11R10 | 0757-0410 | | R:FXD MET FLM 301 OHM 1% 1/8W | 28480 | 0757-0410 |
| A11R11 | 0757-0289 | 1 | R:FXD MET FLM 13.3K OHM 1% 1/8W | 28480 | 0757-0289 |
| A11R12 | C684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R13 | 0684-5631 | 1 | R:FXD COMP 56K OHM 10% 1/4W | 01121 | CB 5631 |
| A11R14 | C684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A11R15 | C698-3193 | 1 | R:FXD FLM 10K OHM 0.25% 1/8W | 28480 | 0698-3193 |
| A11R16 | C698-8025 | 2 | R:FXD FLM 1.91K OHM 0.25% 1/8W | 28480 | 0698-8025 |
| A11R17 | C698-4494 | 1 | R:FXD FLM 35.7K OHM 1% 1/8W | 28480 | 0698-4494 |
| A11R18 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R19 | 0698-8024 | 1 | R:FXD FLM 3.09K OHM 0.25% 1/8W | 28480 | 0698-8024 |
| A11R20 | C698-8025 | | R:FXD FLM 1.91K OHM 0.25% 1/8W | 28480 | 0698-8025 |
| A11R21 | C698-4488 | 1 | R:FXD FLM 26.7K OHM 1% 1/8W | 28480 | 0698-4488 |
| A11R22 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A11R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R24 | C684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A11R25 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A11R26 | 0684-1521 | | R:FXD COMP 1500 OHM 10% 1/4W | 01121 | CB 1521 |
| A12A (STD MODEL 3575A) | 03575-66512 | 1 | BOARD ASSY:METER | 28480 | 03575-66512 |
| A12C1 | C180-2419 | | C:FXD TANT, 470 UF 20% 10VDCW | 56289 | 109D477X0010F2 |
| A12C2 | 0180-2419 | | C:FXD TANT, 470 UF 20% 10VDCW | 56289 | 109D477X0010F2 |
| A12CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A12J1 | 1251-2955 | 4 | CONNECTOR:PC (2 X 25)50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A12L1 | 9100-3337 | 4 | COIL:FXD 100 UH 20% 10 KHZ | 99800 | BP 2650 |
| A12L2 | 9100-3337 | | COIL:FXD 100 UH 20% 10 KHZ | 99800 | BP 2650 |
| A12MP1 | 4040-0749 | | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A12MP2 | 4040-0750 | 2 | EXTRACTOR:PC BOARD, RED | 28480 | 4040-0750 |
| A12R1 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R2 | 0698-4435 | 2 | R:FXD FLM 2.49K OHM 1% 1/8W | 28480 | 0698-4435 |
| A12R3 | 0698-0084 | 2 | R:FXD MET FLM 2.15K OHM 1% 1/8W | 28480 | 0698-0084 |
| A12R4 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R5 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R6 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R7 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R8 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R9 | C698-3358 | 2 | R:FXD MET FLM 1K OHM 0.5% 1/8W | 28480 | 0698-3358 |
| A12R10 | 0684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12R11 | C698-3318 | 2 | R:FXD FLM 200 OHM 0.5% 1/8W | 28480 | 0698-3318 |
| A12B (OPTION 001, 002) | 03575-66522 | 1 | BOARD ASSY:METER | 28480 | 03575-66522 |
| A12 C1 | 0180-2419 | | C:FXD TANT, 470 UF 20% 10VDCW | 56289 | 109D477X0010F2 |
| A12 C2 | 0180-2419 | | C:FXD TANT, 470 UF 20% 10VDCW | 56289 | 109D477X0010F2 |
| A12 J1 | 1251-2955 | | CONNECTOR:PC (2 X 25)50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A12 J2 | 1251-2955 | | CONNECTOR:PC (2 X 25)50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A12 L1 | 9100-3337 | | COIL:FXD 100 UH 20% 10 KHZ | 99800 | BP 2650 |
| A12 L2 | 9100-3337 | | COIL:FXD 100 UH 20% 10 KHZ | 99800 | BP 2650 |
| A12 MP1 | 4040-0749 | | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A12 MP2 | 4040-0750 | | EXTRACTOR:PC BOARD, RED | 28480 | 4040-0750 |
| A12 R1 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R2 | C698-4435 | | R:FXD FLM 2.49K OHM 1% 1/8W | 28480 | 0698-4435 |
| A12 R3 | C698-0084 | | R:FXD MET FLM 2.15K OHM 1% 1/8W | 28480 | 0698-0084 |
| A12 R4 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R5 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R6 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R7 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R8 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R9 | C698-3358 | | R:FXD MET FLM 1K OHM 0.5% 1/8W | 28480 | 0698-3358 |
| A12 R10 | C684-2721 | | R:FXD COMP 2700 OHM 10% 1/4W | 01121 | CB 2721 |
| A12 R11 | C698-3318 | | R:FXD FLM 200 OHM 0.5% 1/8W | 28480 | 0698-3318 |
| A13 | 03575-66513 | 1 | BOARD ASSY:PANEL SWITCH | 28480 | 03575-66513 |
| A13CR1 | 1901-0025 | 14 | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A13S1 | 3100-2726 | 3 | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |
| A13S2 | 3100-2728 | 1 | SWITCH:ROTARY 4-POSITION | 28480 | 3100-2728 |
| A13S3 | 3100-2727 | 1 | SWITCH:ROTARY 3-POSITION | 28480 | 3100-2727 |
| A13S4 | 3100-2726 | | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A13S5 | 3100-2726 | | SWITCH:ROTARY 2-POSITION | 28480 | 3100-2726 |
| A14 | 03575-66514 | 1 | BOARD ASSY:POWER SUPPLY | 28480 | 03575-66514 |
| A14C1 | 0150-0071 | 5 | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C2 | 0160-2207 | 7 | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C3 | 0180-1835 | | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A14C4 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C5 | 0180-1835 | | C:FXD TA 68 UF 20% 15VDCW | 56289 | 150D686X0015R2-DYS |
| A14C6 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C7 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C8 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C9 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C10 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C11 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C12 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C13 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C14 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C15 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C16 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14C17 | 0150-0071 | | C:FXD CER 400 PF 5% 1000VDCW | 56289 | C016B102E401JS27-CDH |
| A14C18 | 0160-2207 | | C:FXD MICA 300 PF 5% | 28480 | 0160-2207 |
| A14C19 | 0180-0106 | | C:FXD ELECT 60 UF 20% 6VDCW | 28480 | 0180-0106 |
| A14CR1 | | | NOT ASSIGNED | | |
| A14CR2 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR3 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR4 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR5 | 1902-0025 | 2 | DIODE,BREAKDOWN:10.0V 5% 400 MW | 28480 | 1902-0025 |
| A14CR6 | 1902-0777 | 1 | DIODE:BREAKDOWN 6.2V 5% | 04713 | 1N825 |
| A14CR7 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR8 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR10 | 1902-0025 | | DIODE,BREAKDOWN:10.0V 5% 400 MW | 28480 | 1902-0025 |
| A14CR11 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR12 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR13 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR14 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR15 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR16 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR17 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14CR18 | 1901-0025 | | DIODE:SILICON 100MA/1V | 07263 | FD 2387 |
| A14IC1 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC2 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC3 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC4 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC5 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC6 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14IC7 | 1820-0223 | | INTEGRATED CIRCUIT:OPERATIONAL AMPL. | 28480 | 1820-0223 |
| A14MP1 | 4040-0749 | | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A14MP2 | 4040-0752 | 1 | EXTRACTOR:PC BOARD, YELLOW | 28480 | 4040-0752 |
| A14MP3 | 1205-0033 | 4 | HEAT SINK:SEMICONDUCTOR | 05820 | 207-CB |
| A14Q1 | 1854-0404 | 3 | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q2 | 1853-0010 | 4 | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q3 | 1854-0226 | 2 | TSTR:SI NPN | 80131 | 2N4384 |
| A14Q4 | 1854-0404 | | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q5 | 1854-0226 | | TSTR:SI NPN | 80131 | 2N4384 |
| A14Q6 | 1854-0404 | | TSTR:SI NPN | 28480 | 1854-0404 |
| A14Q7 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q8 | 1853-0051 | 4 | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q9 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q10 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14Q11 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q12 | 1853-0051 | | TSTR:SI PNP | 80131 | 2N4037 |
| A14Q13 | 1853-0010 | | TSTR:SI PNP(SELECTED FROM 2N3251) | 28480 | 1853-0010 |
| A14R1 | 0811-3079 | 3 | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R2 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R3 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R4 | 0698-3512 | | R:FXD FLM 1180 OHM 1% 1/8W | 28480 | 0698-3512 |
| A14R5 | 0698-8061 | 4 | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R6 | 2100-1758 | 1 | R:VAR WW 1K OHM 5% TYPE V 1W | 28480 | 2100-1758 |
| A14R7 | 0698-8039 | 1 | R:FXD MET FLM 8.87K OHM 0.1% 1/8W | 28480 | 0698-8039 |
| A14R8 | 0811-3079 | | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R9 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R10 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R11 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R12 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R13 | 0811-3056 | 2 | R:FXD WW 0.24 OHM 5% 1/2W | 28480 | 0811-3056 |
| A14R14 | 0757-0284 | | R:FXD MET FLM 150 OHM 1% 1/8W | 28480 | 0757-0284 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A14R15 | 0698-3279 | 2 | R:FXD MET FLM 4990 OHM 1% 1/8W | 28480 | 0698-3279 |
| A14R16 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R17 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R18 | 0698-3153 | 1 | R:FXD MET FLM 3.83K OHM 1% 1/8W | 28480 | 0698-3153 |
| A14R19 | 0757-0444 | 2 | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A14R20 | 0811-3056 | | R:FXD WW 0.24 OHM 5% 1/2W | 28480 | 0811-3056 |
| A14R21 | 0757-0284 | | R:FXD MET FLM 150 OHM 1% 1/8W | 28480 | 0757-0284 |
| A14R22 | 0698-3279 | | R:FXD MET FLM 4990 OHM 1% 1/8W | 28480 | 0698-3279 |
| A14R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R24 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R25 | 0684-3321 | 1 | R:FXD COMP 3300 OHM 10% 1/4W | 01121 | CB 3321 |
| A14R26 | 0698-8061 | | R:FXD FLM 8.25K OHM 0.1% 1/8W | 28480 | 0698-8061 |
| A14R27 | 0698-8058 | 1 | R:FXD FLM 5.90K OHM 0.25% 1/4W | 28480 | 0698-8058 |
| A14R28 | 0811-3079 | | R:FXD WW 0.51 OHM 5% 1/2W | 28480 | 0811-3079 |
| A14R29 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R30 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R31 | 0698-3258 | 1 | R:FXD MET FLM 5.36K OHM 1% 1/8W | 28480 | 0698-3258 |
| A14R32 | 0757-0444 | | R:FXD MET FLM 12.1K OHM 1% 1/8W | 28480 | 0757-0444 |
| A14R33 | 0811-3071 | 4 | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R34 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R35 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R36 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R37 | 0698-8059 | 2 | R:FXD FLM 4.32K OHM 0.1% 1/8W | 28480 | 0698-8059 |
| A14R38 | 0698-8060 | 2 | R:FXD FLM 8.64K OHM 0.1% 1/8W | 28480 | 0698-8060 |
| A14R39 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R40 | 0811-3071 | | R:FXD WW 1.2 OHM 5% 1W | 28480 | 0811-3071 |
| A14R41 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R42 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A14R43 | 0698-8059 | | R:FXD FLM 4.32K OHM 0.1% 1/8W | 28480 | 0698-8059 |
| A14R44 | 0698-8060 | | R:FXD FLM 8.64K OHM 0.1% 1/8W | 28480 | 0698-8060 |
| A14R45 | | | NOT ASSIGNED | | |
| A14R46 | | | NOT ASSIGNED | | |
| A14R47 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A14R48 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A15 | 03575-66515 | 1 | BOARD ASSY:POWER SUPPLY(MOTHER BD) | 28480 | 03575-66515 |
| A15C1 | 0180-2384 | 1 | C:FXD AL ELECT DUAL 3500/1200 UF 15/25V | 56289 | 96BD20105 |
| A15C2 | 0180-2388 | 1 | C:FXD AL ELECT DUAL 3500/1200 UF 15/25V | 28480 | 0180-2388 |
| A15C3 | 0180-2394 | 1 | C:FXD AL ELECT 3000 UF +100-10% 10VDCW | 56289 | 68D10359 |
| A15CR1 | 1901-0028 | 12 | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR2 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR3 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR4 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR5 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR6 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR7 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR8 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR9 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR10 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR11 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15CR12 | 1901-0028 | | DIODE:SILICON 0.75A 400PIV | 04713 | SR1358-9 |
| A15Q1 | 1854-0072 | 3 | TSTR:SI NPN | 80131 | 2N3054 |
| A15Q2 | 1854-0072 | | TSTR:SI NPN | 80131 | 2N3054 |
| A15Q3 | 1854-0063 | 2 | TSTR:SI NPN | 80131 | 2N3055 |
| A15Q4 | 1854-0063 | | TSTR:SI NPN | 80131 | 2N3055 |
| A15Q5 | 1854-0072 | | TSTR:SI NPN | 80131 | 2N3054 |
| A15XA14A | 1251-2034 | 1 | CONNECTOR PC EDGE (2 X 10) 20 CONTACT | 71785 | 252-10-30-300 |
| A16A(STD & OPT 001 | 03575-26516 | | BOARD ASSY: INTERFACE SUBSTITUTION | 28480 | 03575-26516 |
| A16B(OPT 002 ONLY) | 03575-66518 | 1 | BOARD ASSY:INTERFACE | 28480 | 03575-66518 |
| A16C1 | 0160-3452 | 6 | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C2 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C3 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C4 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C5 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C6 | 0160-3452 | | C:FXD DISC CER 0.02 UF 20% 100VDCW | 56289 | C023B101H203MS25-CDH |
| A16C7 | 0150-0050 | 4 | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C8 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C9 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C10 | 0180-0291 | 3 | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A16C11 | 0150-0050 | | C:FXD CER 1000 PF +80-20% 1000VDCW | 56289 | C067B102E102ZS26-CDH |
| A16C12 | 0180-0309 | | C:FXD ELECT 4.7 UF 20% 10VDCW | 56289 | 150D475X0010A2-DYS |
| A16C13 | 0160-3658 | 1 | C:FXD POLY 10 UF 10% 50VDCW | 28480 | 0160-3658 |
| A16C14 | 0180-0291 | | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A16C15 | 0180-0291 | | C:FXD ELECT 1.0 UF 10% 35VDCW | 56289 | 150D105X9035A2-DYS |
| A16CR1 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A16CR2 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A16CR3 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A16CR4 | 1901-0040 | | DIODE:SILICON 30MA 30WV | 07263 | FDG1088 |
| A16IC1 | 1820-0668 | 1 | IC:TTL HEX DRIVER W/OPEN COLL(30V) | 01295 | SN7407N |
| A16IC2 | 1820-0174 | 3 | IC:TTL HEX INVERTER | 01295 | SN7404N |
| A16IC3 | 1820-0511 | | IC:TTL QUAD 2-INPT AND GATE | 01295 | SN7408N |
| A16IC4 | 1820-0301 | 6 | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC5 | 1820-0301 | | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC6 | 1820-0174 | | IC:TTL HEX INVERTER | 01295 | SN7404N |
| A16IC7 | 1820-0301 | | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC8 | 1820-0511 | | IC:TTL QUAD 2-INPT AND GATE | 01295 | SN7408N |
| A16IC9 | 1820-0301 | | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC10 | 1820-0301 | | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC11 | 1820-0174 | | IC:TTL HEX INVERTER | 01295 | SN7404N |
| A16IC12 | 1820-0301 | | IC:TTL QUAD BI-STABLE D-LATCH | 01295 | SN7475N |
| A16IC13 | 1820-0506 | 2 | IC:DIGITAL 2-INPT,4-BIT MULTIPLEXER | 18324 | N82668 |
| A16IC14 | 1820-0506 | | IC:DIGITAL 2-INPT,4-BIT MULTIPLEXER | 18324 | N82668 |
| A16IC15 | 1820-0515 | 1 | IC:TTL DUAL RE-TRIG/RE-SET MONO-MULTI | 07263 | U78960259X |
| A16IC16 | 1820-0068 | | IC:TTL TRIPLE 3-INPUT POS NAND GATE | 12040 | SN7410N |
| A16IC17 | 1820-0054 | | IC:TTL QUAD 2-INPT NAND GATE | 01295 | SN7400N |
| A16MP1 | 4040-0747 | | EXTRACTOR:PC BOARD, GRAY | 28480 | 4040-0747 |
| A16MP2 | 4040-0749 | | EXTRACTOR:PC BOARD, BROWN | 28480 | 4040-0749 |
| A16Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q2 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q3 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q4 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q5 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q6 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q7 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q8 | 1853-0020 | | TSTR:SI PNP(SELECTED FROM 2N3702) | 28480 | 1853-0020 |
| A16Q9 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16Q10 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A16R1 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R2 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R3 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R4 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R5 | 1810-0041 | 1 | R:NETWORK,8 RES. 2.7K OHM 5% | 28480 | 1810-0041 |
| A16R6 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R7 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R8 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R9 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R10 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R11 | 0683-1245 | 1 | R:FXD COMP 120K OHM 5% 1/4W | 01121 | CB 1245 |
| A16R12 | 0683-1255 | 1 | R:FXD COMP 1.2 MEGOHM 5% 1/4W | 01121 | CB 1255 |
| A16R13 | 0683-1265 | 1 | R:FXD COMP 12 MEGOHM 5% 1/4W | 01121 | CB 1265 |
| A16R14 | 0698-3228 | 2 | R:FXD MET FLM 49.9K OHM 1% 1/8W | 28480 | 0698-3228 |
| A16R15 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R16 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R17 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R18 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R19 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R20 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R21 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R22 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R23 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R24 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R25 | 0757-0476 | 1 | R:FXD MET FLM 301K OHM 1% 1/8W | 28480 | 0757-0476 |
| A16R26 | 0698-3228 | | R:FXD MET FLM 49.9K OHM 1% 1/8W | 28480 | 0698-3228 |
| A16R27 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R28 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16R29 | 0683-1235 | 1 | R:FXD COMP 12K OHM 5% 1/4W | 01121 | CB 1235 |
| A16R30 | 0684-4721 | | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A16R31 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A16R32 | 0684-1041 | | R:FXD COMP 100K OHM 10% 1/4W | 01121 | CB 1041 |
| A16R33 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R34 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R35 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R36 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R37 | 0684-1031 | | R:FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |
| A16R38 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R39 | 0684-1021 | | R:FXD COMP 1000 OHM 10% 1/4W | 01121 | CB 1021 |
| A16R40 | 0684-5621 | | R:FXD COMP 5.6K OHM 10% 1/4W | 01121 | CB 5621 |
| A16XA19 | 1251-2955 | | CONNECTOR:PC (2 X 25)50 CONTACT | 05574 | 3KH25/21JV12/079 |
| A17 | 03575-66517 | 1 | BOARD ASSY:MOTHER | 28480 | 03575-66517 |
| A17XA1 | 1251-1604 | 9 | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA2 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |
| A17XA3 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number | |
|---|---|---|---|---|---|---|
| A17XA4 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA5 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA6 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA7 | 1251-1365 | 4 | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 | |
| A17XA8 | 1251-1365 | | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 | |
| A17XA9 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA10 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA11 | 1251-1604 | | CONNECTOR:PC EDGE 1 ROW 22 CONTACT | 71785 | 252-22-30-310 | |
| A17XA12 | 1251-1365 | | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 | |
| A17XA13 | 1251-1633 | 1 | CONNECTOR:PC(1 X 15) 15 CONTACT | 71785 | 252-15-30-310 | |
| A17XA14 | 1251-1632 | 1 | CONNECTOR:PC 1 X 12 CONTACT | 71785 | 252-12-30-310 | |
| A17XA16 | 1251-1365 | | CONN:PC 44 (2X22) CONTACTS | 71785 | 252-22-30-300 | |
| A18 | 5060-1200 | 1 | MODULE PWR INPUT | 28480 | 5060-1200 | |
| A19(OPT 002 ONLY) | C3575-66519 | 1 | BOARD ASSY:INTERFACE CONNECTOR | 28480 | 03575-66519 | |
| A19J1 | 1251-0087 | 1 | CONNECTOR:FEMALE 50-PIN MINAT | 28480 | 1251-0087 | |
| A19MP1 | 03575-01208 | 1 | BRACKET:INTERFACE CONNECTOR | 28480 | 03575-01208 | |
| A19MP2 | 1530-1698 | 1 | SUPPORT:PC BOARD | 28480 | 1530-1698 | |
| A20A B † | 03431-60005 | 1 | ASSY CONTROL LOGIC (INCLUDES MOTHER BOARD A20A AND LOGIC BOARD A20B) | 28480 | 03431-60005 | |
| A20A | | | BOARD ASSY MOTHER | 28480 | | |
| A20B | | | BOARD ASSY LOGIC | | | |
| A20CR1 THRU CR5 | 1902-3190 | | DIODE BREAKDOWN 13 V 5 | 07910 | CD3573S | |
| A20CR6 THRU CR10 | 1901-0040 | | DIODE Si 30 WIV 50 mA 2 pF 2 ns | 07263 | FDG1088 | |
| A20CR11 | 1910-0016 | | DIODE Ge 60 WIV 1 US Trr | 82219 | D2361 | |
| A20IC1 † | 1820-0671 | 1 | IC CONTROL LOGIC | 28480 | 1820-0671 | |
| A20IC2 † | 1820-0698 | 1 | IC TRI DECADE BUFFER | 28480 | 1820-0698 | |
| A21 † | 03431-66513 | 1 | BOARD ASSY ANALOG | 28480 | 03431-66513 | |
| A21C1 | 0160-3674 | | C FXD 0.47 UF 5 100 VDCW | 84411 | HEW132 | |
| A21C2, C3 | 0160-0990 | | C FXD MICA 100 pF 2 | 72136 | RDM15F101G3S | obd |
| A21C4 | 0160-0181 | | C FXD MICA 30 pF 5 | 14655 | RDM15E300J3S | |
| A21CR1, CR2 | 1902-0686 | 2 | DIODE BREAKDOWN 6.2 V 2 | 04713 | SZ12170 | |
| A21CR3, CR4 | 1901-0040 | | DIODE Si 30 WIV 50 mA 2 pF 2 ns | 07263 | FDG1088 | |
| A21IC1 † | 0960-0160 | 1 | IC A-D HYBRID | 28480 | 0960-0160 | |
| A21MP1 | 03431-01201 | 2 | BRACKET MOUNTING | 28480 | 03431-01201 | |
| A21Q1, Q2 | 1854-0071 | | TSTR Si NPN 2N3391 | 01295 | SKA1124 | |
| A21Q3 | 1853-0020 | | TSTR Si PNP | 01295 | SKA1123 | |
| A21R1, R2 | 2100-2030 | 2 | R VAR CER 20 K OHM 10 1 2 W | 73138 | 62-210-1 | |
| A21R3 | 2100-2497 | 1 | R VAR CER 2 K OHM 10 1 2 W | 73138 | 62-207-1 | |
| A21R4 | 0757-0488 | | R FXD FLM 909 K OHM 1 1 8 W | 75042 | CEA T-0 | |
| A21R5 | 2100-1738 | 1 | R VAR CER 10 K OHM 10 1 2 W | 73138 | 62-209-1 | |
| A21R6 | 2100-3207 | 1 | R VAR CER 5 K OHM 10 1 2 W | 28480 | 1200-3207 | |
| A21R7 | 0757-0199 | | R FXD FLM 21.5 K OHM 1 1 8 W | 75042 | CEA T-0 | obd |
| A21R8 | 0757-0283 | | R FXD FLM 2 K OHM 1 1 8 W | 75042 | CEA T-0 | obd |
| A21R9 | 0757-0442 | | R FXD FLM 10 K OHM 1 1 8 W | 19701 | MF4C T-0 | obd |
| A21R10 | 0698-4477 | | R FXD FLM 10.5 K OHM 1 1 8 W | 91637 | CMF-1 10.32 T-1 | obd |
| A21R11 | 0757-0448 | | R FXD FLM 18.2 K OHM 1 1 8 W | 19701 | MF4C T-0 | obd |
| A21R12 | 0757-0442 | | R FXD FLM 10 K OHM 1 1 8 W | 19701 | MF4C T-0 | obd |
| A21R13 | 0698-4488 | | R FXD FLM 26.7 K OHM 1 1 8 W | 91637 | CMF-1 10.32 T-1 | obd |
| A21R14 | 0757-0442 | | R FXD FLM 10 K OHM 1 1 8 W | 19701 | MF4C | obd |
| A22 † | 03431-66501 | 1 | ASSY DISPLAY (DOES NOT INCLUDE DS1) | 28480 | 03431-66501 | |
| A22IC1 | 0160-0155 | 1 | C FXD MY 0.0033 UF 10 200 VDCW | 56289 | 192P33292-PTS | |
| A22IC2 | 0180-0106 | 1 | C FXD ELECT 60 UF 20 6 VDCW | 28480 | 0180-0106 | |
| A22DS1 † | 1990-0315 | 1 | DISPLAY NUMERIC | 28480 | 1990-0315 | |
| A22DS2 | 1990-0310 | 9 | DIODE VISIBLE LIGHT EMITTER | 28480 | 1990-0310 | |
| A22DS3 THRU DS10 | 1990-0310 | | DIODE VISIBLE LIGHT EMITTER | 28480 | 1990-0310 | |
| A22IC1 † | 1820-0663 | 1 | IC DIGITAL SCANNER | 28480 | 1820-0663 | |
| A22IC2 † | 1820-0571 | 1 | IC TTL DIGITAL | 28480 | 1820-0571 | |
| A22MP1 | 5040-5839 | 1 | HOUSING ANNUNCIATOR | 28480 | 5040-5839 | |
| A22MP2 | 03575-24301 | 1 | MASK ANNUNCIATION | 28480 | 03575-24301 | |
| A22MP3 | 1200-0448 | 74 | SOCKET CONTACT DIP | 27264 | 1938-4G1 | |
| A22Q1 | 1854-0094 | 6 | TSTR Si NPN | 80131 | 2N3646 | |
| A22Q2 THRU Q6 | 1854-0094 | | TSTR Si NPN | 80131 | 2N3646 | |
| A22Q7 | 1853-0016 | 13 | TSTR Si PNP | 80131 | 2N3638 | |
| A22Q8 THRU Q18 | 1853-0016 | | TSTR Si PNP | 80131 | 2N3638 | |
| A22R1 | 1810-0066 | 1 | R NETWORK 4 (2) = 650 (2) = 350 OHM 10 | 28480 | 1810-0066 | |
| A22R2 | 1810-0067 | 1 | R NETWORK 6 (2) = 190 (3) = 510 OHM | 28480 | 1810-0067 | |
| A22R3 | 1810-0068 | 1 | R NETWORK 3 X 410 OHM 10 | 28480 | 1810-0068 | |
| A22R4 | 1810-0069 | 1 | R NETWORK 9 X 48 OHM 10 0.05 W EACH | 28480 | 1810-0069 | |
| A23A B † (OPT 001, 002 ONLY) | 03431-60005 | | ASSY CONTROL LOGIC (INCLUDES MOTHER BOARD A23A AND LOGIC BOARD A23B) | 28480 | 03431-60005 | |
| A23A (SAME AS A20A) | | | BOARD ASSY MOTHER | 28480 | | |
| A23B (SAME AS A20B) | | | BOARD ASSY LOGIC | 28480 | | |
| A24 * (OPT 001, 002 ONLY; SAME AS A21) | 03431-66513 | | BOARD ASSY ANALOG | 28480 | | |
| A25 † (OPT 001, 002 ONLY; SAME AS A22) | 03431-66501 | | BOARD ASSY DISPLAY | 28480 | | |

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | CHASSIS MOUNTED COMPONENTS | | |
| C1 | 0160 3441 | 2 | C FXD CER 0.002 UF 20 3 K VDCW | 71590 | DD30 202 |
| C2 | 0160 3441 | | C FXD CER 0.002 UF 20 3 K VDCW | 71590 | DD30 202 |
| F1 | 2110 0336 | 1 | FUSE SLOW BLOW 0.6 A 250 V (115 V OPERATION) | | |
| F1 | 2110 0044 | 1 | FUSE SLOW BLOW 0.3 A 250 V (230 V OPERATION) | | |
| J1 | | | CONNECTOR INPUT (POW1) | | |
| J2 | | | CONNECTOR INPUT (POW2) | | |
| J3 | 1250 0083 | 2 | CONNECTOR RF | 77068 | 30624 1 |
| J4 | 1250 0083 | | CONNECTOR RF | 77068 | 30624 1 |
| J5 | 1510 0076 | 1 | POST BINDING JADE GRAY | 28480 | 1510 0076 |
| S1 | 3101 0896 | 1 | SWITCH TOGGLE | 28480 | 3101 0896 |
| S2 | 3101 1179 | 1 | SWITCH TOGGLE | 28480 | 3101 1179 |
| T1 | 9100 3237 | 1 | XFMR POWER | 28480 | 9100 3237 |

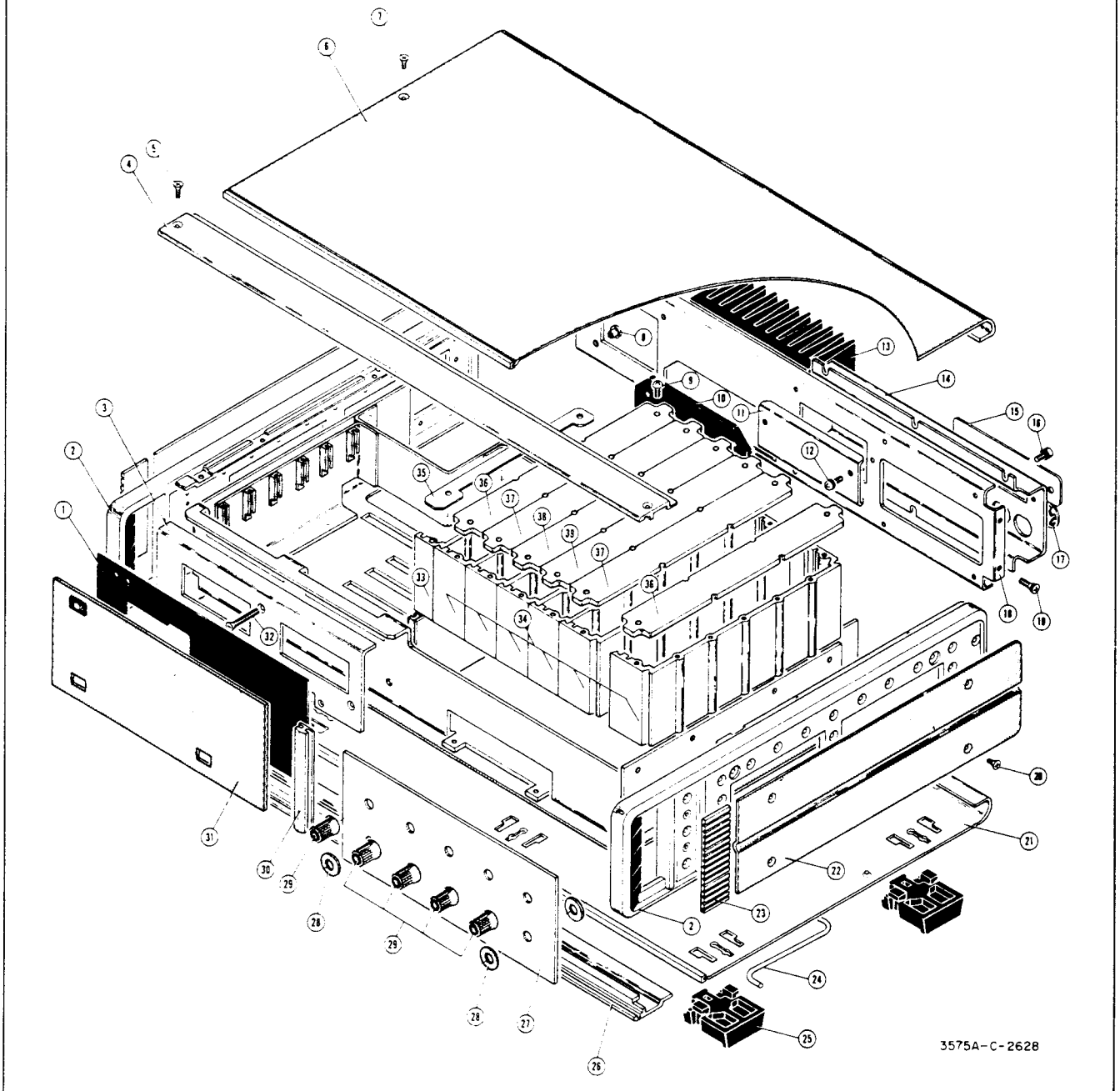



Figure 6-1 Mechanical Parts (Mainframe)

## Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | CABLES | | |
| W1 | 03575-61601 | 2 | CABLE ASSY INPUT (INCLUDES J1) | 28480 | 03575-61601 |
| W2 | 03575-61601 | | CABLE ASSY INPUT (INCLUDES J2) | 28480 | 03575-6160 |
| ‡ W3 | 03575-61613 | 2 | CABLE ASSY PREAMP (INCLUDES P1/J1 AND P2) | 28480 | 03575-61613 |
| ‡ W4 | 03575-61613 | | CABLE ASSY PREAMP (INCLUDES P1/J1 AND P2) | 28480 | 03575-61613 |
| W5 | 03575-61603 | 1 | CABLE ASSY CHANNEL A (INCLUDES P1 AND P2) | 28480 | 03575-61603 |
| W6 | 03575-61604 | 1 | CABLE ASSY CHANNEL B (INCLUDES P1 AND P2) | 28480 | 03575-61604 |
| W7 | 03575-61605 | 1 | CABLE ASSY CURRENT (INCLUDES P1/J1 AND P2) | 28480 | 03575-61605 |
| W8 | 03575-61606 | 2 | CABLE ASSY (BETWEEN J1 AND CHASSIS) | 28480 | 03575-61606 |
| W9 | 03575-61606 | | CABLE ASSY (BETWEEN J2 AND CHASSIS) | 28480 | 03575-61606 |
| W10 | 03575-61607 | 1 | CABLE ASSY POWER SWITCH | 28480 | 03575-61607 |
| W11 | 03575-61608 | 1 | CABLE ASSY (BETWEEN J5 AND CHASSIS) | 28480 | 03575-61608 |
| W12 | 8120-1378 | 1 | CABLE POWER | 28480 | 8120-1378 |
| | | | MECHANICAL PARTS (REFER TO FIGURES 6-1 AND 6-2) | | |
| MP1 (STD 3575A) | 7101-0266 | 1 | MASK DISPLAY | 28480 | 7101-0266 |
| MP1 (OPT 001, 002) | 7101-0265 | 1 | MASK DISPLAY | 28480 | 7101-0265 |
| MP2 | 03575-21201 | 2 | ASSY FRAME | 28480 | 03575-21201 |
| MP3 | 03575-01204 | 1 | PANEL DISPLAY | 28480 | 03575-01204 |
| MP4 | 03575-26802 | 1 | TRIM TOP PANEL | 28480 | 03575-26802 |
| MP5 | 2360-0184 | 4 | SCREW | | |
| MP6 | 03575-04101 | 1 | COVER ASSY TOP | 28480 | 03575-04101 |
| MP7 | 2360-0196 | | SCREW | | |
| MP8 | 0390-0006 | 4 | BUSHING (FOR T1) | | |
| MP9 | 2200-0766 | 59 | SCREW MACH | | |
| MP10 | 03575-01207 | 1 | BRACKET TSTR MTNG | 28480 | 03575-01207 |
| MP11 | 03575-04104 | 1 | COVER AC TERMINAL | 28480 | 03575-04101 |
| MP12 | 2200-0766 | | SCREW MACH | | |
| MP13 | 03575-21101 | 1 | HEAT SINK POWER SUPPLY | 28480 | 03575-21101 |
| MP14 | 03575-00203 | 1 | PANEL CONNECTOR MTNG | 28480 | 03575-00203 |
| MP15 | 03575-04103 | 1 | COVER INTERFACE CONN | 28480 | 03575-04103 |
| MP16 | 2360-0195 | | SCREW | | |
| | 2190-0198 | | WASHER LOCK | | |
| MP17 | 6960-0010 | 2 | PLUG HOLE | | |
| MP18 | 03575-00202 | 1 | PANEL REAR | 28480 | 03575-00202 |
| MP19 | | | | | |
| RIGHT SIDE | 2510-0050 | | SCREW | | |
| | 03575-24103 | 1 | PLATE SPACER | 28480 | 03575-24103 |
| LEFT SIDE | 2510-0052 | | SCREW | | |
| | 2510-0190 | 1 | SCREW INSULATOR | 28480 | 03575-24108 |
| | 03575-24108 | | SPACER INSULATOR | | |
| | 2190-0343 | | WASHER INSULATOR | | |
| | 3050-0026 | | WASHER FLAT | | |
| | 2190-0087 | | WASHER LOCK | | |
| | 2580-0015 | | NUT | | |
| MP20 | 2360-0192 | | SCREW | | |
| MP21 | 03575-04102 | 1 | COVER ASSY BOTTOM | 28480 | 03575-04102 |
| MP22 | 5000-8589 | 2 | COVER SIDE | 28480 | 5000-8589 |
| MP23 | 5000-0050 | 2 | PLATE FLUTED | 28480 | 5000-0050 |
| MP24 | 1490-0030 | 1 | STAND TILT | 28480 | 1490-0030 |
| MP25 | 5060-0767 | 5 | ASSY FOOT | 28480 | 5060-0767 |
| MP26 | 03575-26803 | 1 | TRIM BOTTOM PANEL | 28480 | 03575-26803 |
| MP27 | 03575-00201 | 1 | PANEL FRONT | 28480 | 03575-00201 |
| MP28 | 00310-48801 | 4 | WASHER SHLDR | 28480 | 00310-48801 |
| MP29 | 0370-1099 | 5 | KNOB POINTER | 28480 | 0370-1099 |
| MP30 | 03575-26801 | 1 | TRIM CENTER | 28480 | 03575-26801 |
| MP31 (STD 3575A) | 03575-40201 | 1 | WINDOW DISPLAY | 28480 | 03575-40201 |
| MP31 (OPT 001, 002) | 03575-40202 | 1 | WINDOW DISPLAY | 28480 | 03575-40202 |
| MP32 | 2200-0084 | 4 | SCREW | | |
| MP33 | 03575-25502 | 1 | SHIELD CARD NEST | 28480 | 03575-25502 |
| MP34 | 03575-25501 | 6 | SHIELD CARD NEST | 28480 | 03575-25501 |
| MP35 | 03575-01209 | 1 | STRAP RETAINER | 28480 | 03575-01209 |
| MP36 | 03575-24104 | 2 | COVER A1/A2 | 28480 | 03575-24104 |
| MP37 | 03575-24105 | 2 | COVER A3/A4 | 28480 | 03575-24105 |
| MP38 | 03575-24107 | 1 | COVER A6 | 28480 | 03575-24107 |
| MP39 | 03575-24106 | 1 | COVER A5 | 28480 | 03575-24106 |
| MP40 | 5020-6871 | 1 | COVER PNL MTR | 28480 | 5020-6871 |
| MP41 | 5000-9520 | 1 | INSULATOR | 28480 | 5000-9520 |
| MP42 | 3030-0009 | 2 | SCREW SET | | |
| MP43 | 5000-9523 | 1 | INSULATOR | 28480 | 5000-9523 |

‡ See Appendix C, Manual Backdating, Change 2

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| | | | MISCELLANEOUS PARTS | | |
| | 03575-01211 | 1 | BRACKET INTERFACE BOARD (REINFORCES A16B) | 28480 | 03575-01211 |
| | 1410-1017 | 10 | BUSHING INSULATOR (FOR A15-01 -05 MTNG) | 28480 | 1410-1017 |
| | 5000-5085 | 1 | CLIP POWER MODULE (A18) | 28480 | 5000-5085 |
| | 0510-0075 | 4 | CLIP TINNERMAN (TOP AND BOTTOM COVERS) | 28480 | 0510-0075 |
| | 5040-5932 | 1 | COVER POWER SWITCH | 28480 | 5040-5932 |
| | 0403-0151 | 2 | GUIDE PC BOARD GREY | 28480 | 0403-0151 |
| | 0403-0152 | 3 | GUIDE PC BOARD BLACK | 28480 | 0403-0152 |
| | 0403-0153 | 4 | GUIDE PC BOARD BROWN | 28480 | 0403-0153 |
| | 0403-0154 | 1 | GUIDE PC BOARD RED | 28480 | 0403-0154 |
| | 0403-0156 | 1 | GUIDE PC BOARD YELLOW | 28480 | 0403-0156 |
| | 0403-0160 | 2 | GUIDE PC BOARD WHITE | 28480 | 0403-0160 |
| | 0340-0704 | 2 | INSULATOR (FOR J5) | | |
| | 03575-24101 | 1 | INSULATOR PLATE (BETWEEN CHASSIS AND A17) | 28480 | 03575-24101 |
| | 0340-0770 | 1 | INSULATOR TSTR BRKT (BETWEEN CHASSIS AND A15) | 28480 | 0340-0770 |
| | 1200-0043 | 2 | INSULATOR TSTR (FOR A15-Q3, Q4) | 28480 | 1200-0043 |
| | 0340-0162 | 3 | INSULATOR TSTR (FOR A15-Q1, Q2, Q5) | 28480 | |
| | 03575-84401 | 1 | KIT ACCESSORY, INCLUDES THE FOLLOWING | 28480 | 03575-84401 |
| | 5060-5987 | 1 | EXTENDER PC 2 X 10 PIN | 28480 | 5060-5987 |
| | 5060-5988 | 1 | EXTENDER PC 2 X 12 PIN | 28480 | 5060-5988 |
| | 5060-5989 | 1 | EXTENDER PC 2 X 22 PIN | 28480 | 5060-5989 |
| | 5060-8739 | 1 | KIT RACK MOUNTING, INCLUDES THE FOLLOWING | 28480 | 5060-8739 |
| | 5020-7619 | 1 | BRACKET LEFT SIDE | 28480 | 5020-7619 |
| | 5020-7620 | 1 | BRACKET RIGHT SIDE | 28480 | 5020-7620 |
| | 5040-6677 | 1 | STRIP FILLER | 28480 | 5040-6677 |
| | 2510-0047 | 4 | SCREW MACH SS 8 32 X 0.312 PHILLIPS DRIVE | | |

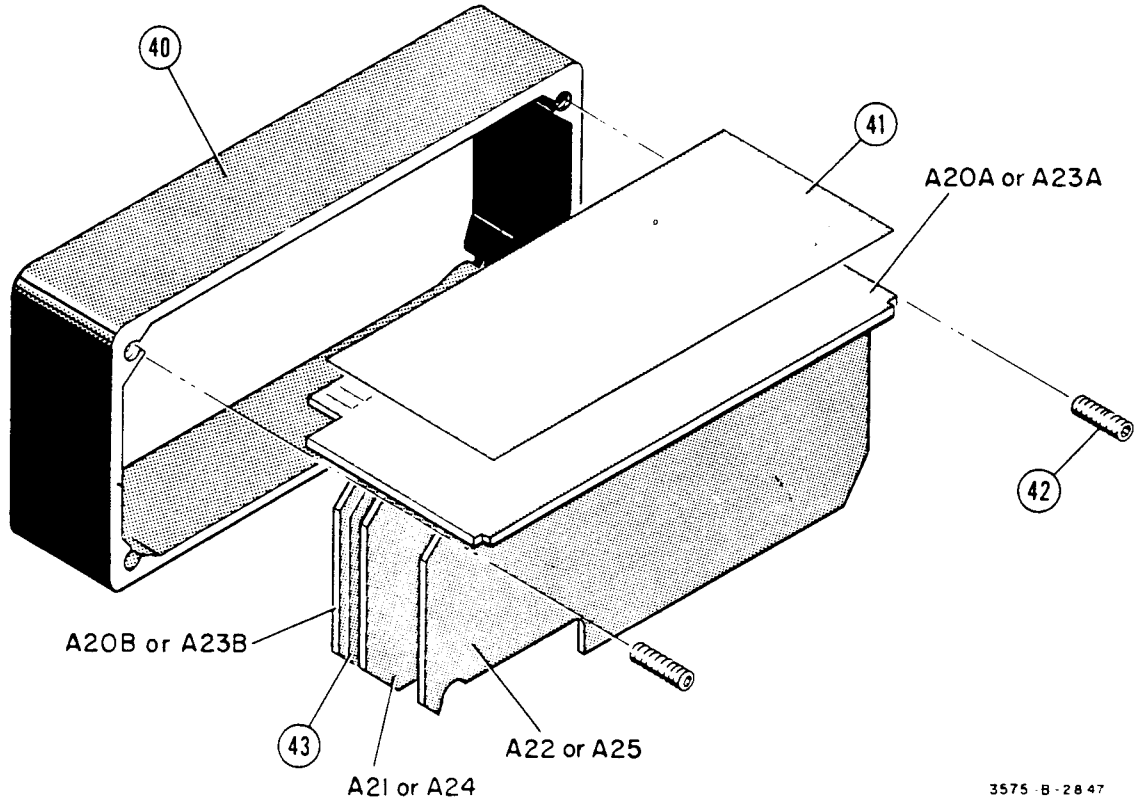
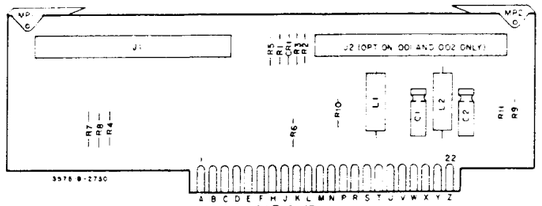



Figure 6-2. Mechanical Parts (Panel Frame)

Table 7-1. Assembly Cross Reference.

| Assembly Number | Assembly Title | Assembly Part Number | Schematic Number | Figure Number |
|---|---|---|---|---|
| A1 | Preamplifier Assembly | 03575-66501 | 1 | 7-2 |
| A2 | Preamplifier Assembly | 03575-66501 | 1 | 7-2 |
| A3 | Log Converter Assembly | 03575-66503 | 1 | 7-2 |
| A4 | Log Converter Assembly | 03575-66503 | 1 | 7-2 |
| A5 | Phase Detector Assembly | 03575-66505 | 2 | 7-3 |
| A6 | Current Source Assembly | 03575-66506 | 3 | 7-4 |
| A7 | Phase Control Filter Assembly | 03575-66507 | 4 | 7-5 |
| A8 | Function Switching Assembly | 03575-66508 | 5 | 7-6 |
| A9 | Output Filter Assembly | 03575-66509 | 6 | 7-7 |
| A10* | Output Filter Assembly | 03575-66509 | 6 | 7-7 |
| A11 | Phase Control Logic Assembly | 03575-66511 | 3 | 7-4 |
| A12A | Panel Meter Connector Assembly | 03575-66512 | 7, 10 | 7-8, 7-11 |
| A12B* | Panel Meter Connector Assembly | 03575-66522 | 7, 10 | 7-8, 7-11 |
| A13 | Front Panel Switching Assembly | 03575-66513 | 5 | 7-6 |
| A14 | Power Supply Assembly | 03575-66514 | 8 | 7-9 |
| A15 | Power Supply Mother Board Assembly | 03575-66515 | 8 | 7-9 |
| A16A | Interface Substitution Assembly | 03575-26516 | 5 | 7-6 |
| A16B** | Interface Assembly | 03575-66518 | 9 | 7-10 |
| A17 | Mother Board Assembly | 03575-66517 | | |
| A18 | Power Input Module | 5060-1200 | 8 | 7-9 |
| A19** | Interface Connector Assembly | 03575-66519 | 9 | 7-10 |
| A20A/B | Control Logic Assembly | 03431-60005 | 7 | 7-8 |
| A21 | Analog Assembly | 03431-66513 | 7 | 7-8 |
| A22 | Display Assembly | 03431-66501 | 7 | 7-8 |
| A23A/B* | Control Logic Assembly | 03431-60005 | 10 | 7-11 |
| A24* | Analog Assembly | 03431-66513 | 10 | 7-11 |
| A25* | Display Assembly | 03431-66501 | 10 | 7-11 |

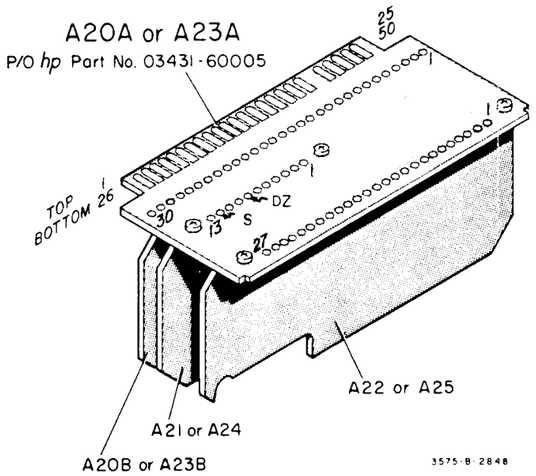
* Options 001, 002 only. ** Option 002 only.



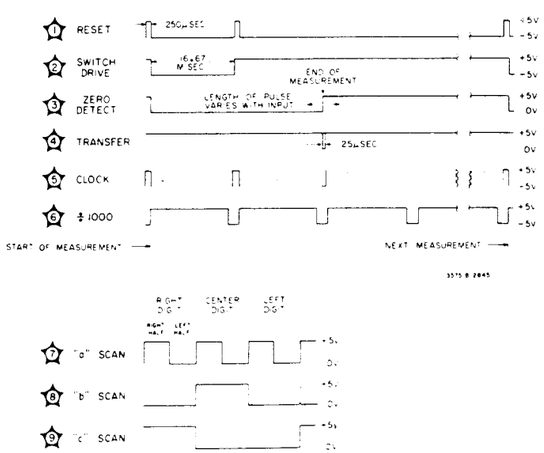
A12 A/B

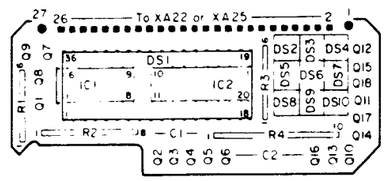
*hp* Part No. 03575-66512

Rev B




3575-B-2848

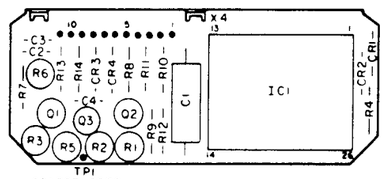



A22 or A25

*hp* Part No. 03431-66501

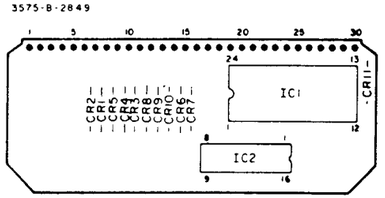
Rev A




A21 or A24

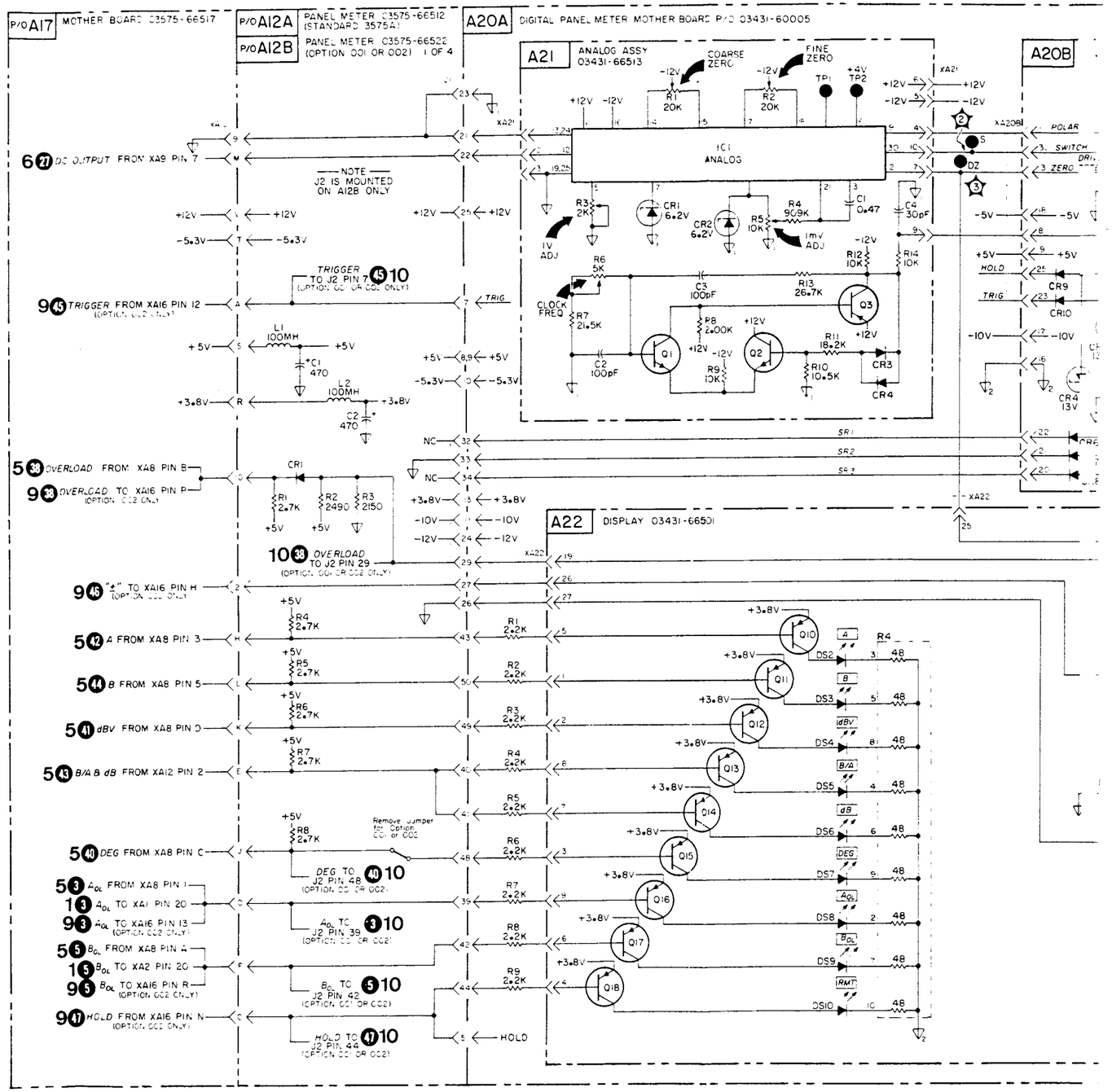
*hp* Part No. 03431-66513

3575-B-2849




A20B or A23B

P/O *hp* Part No. 03431-60005



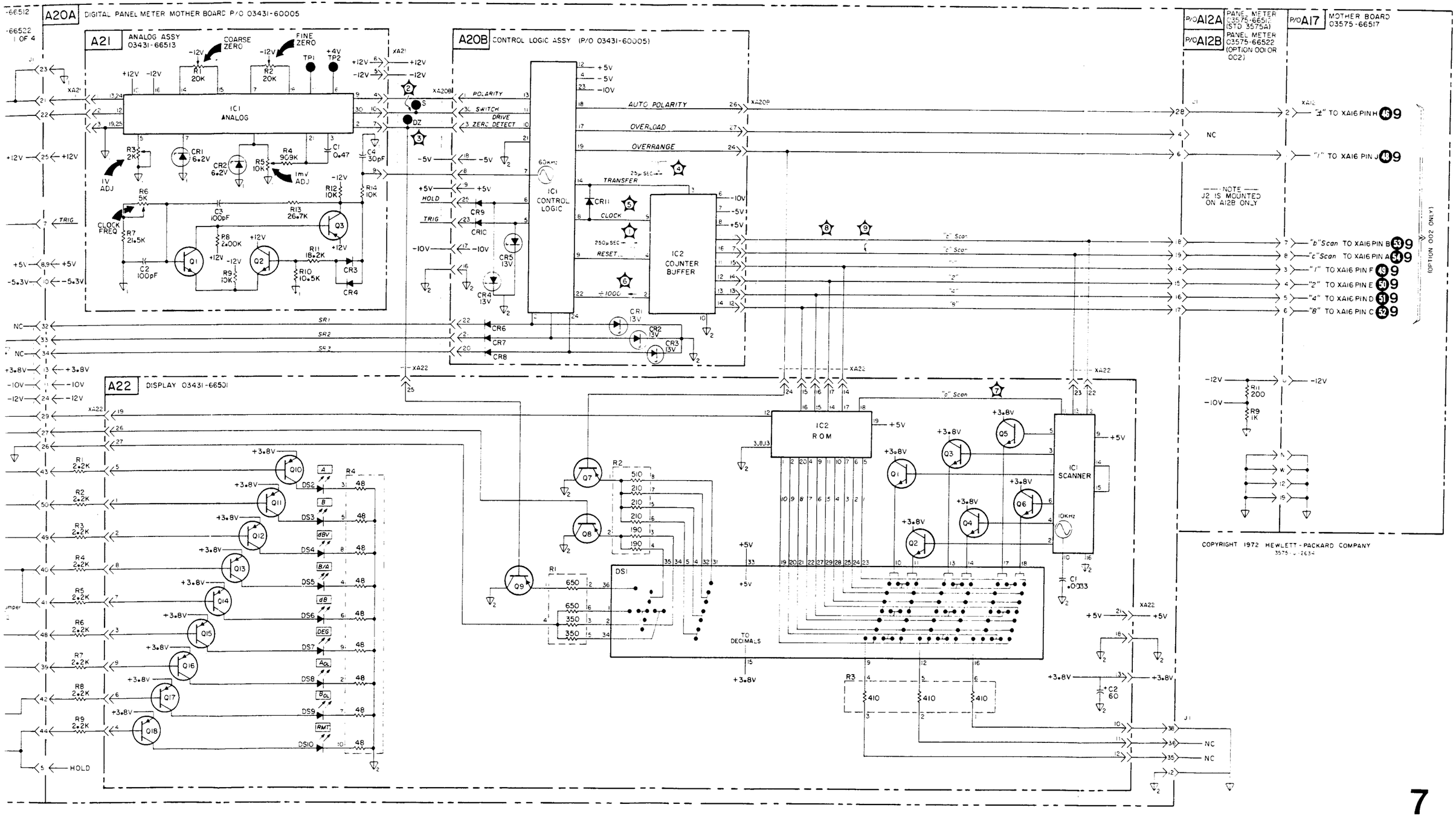
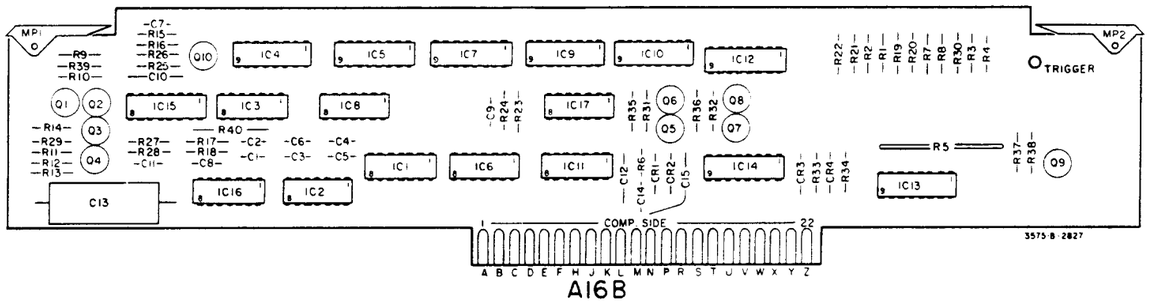
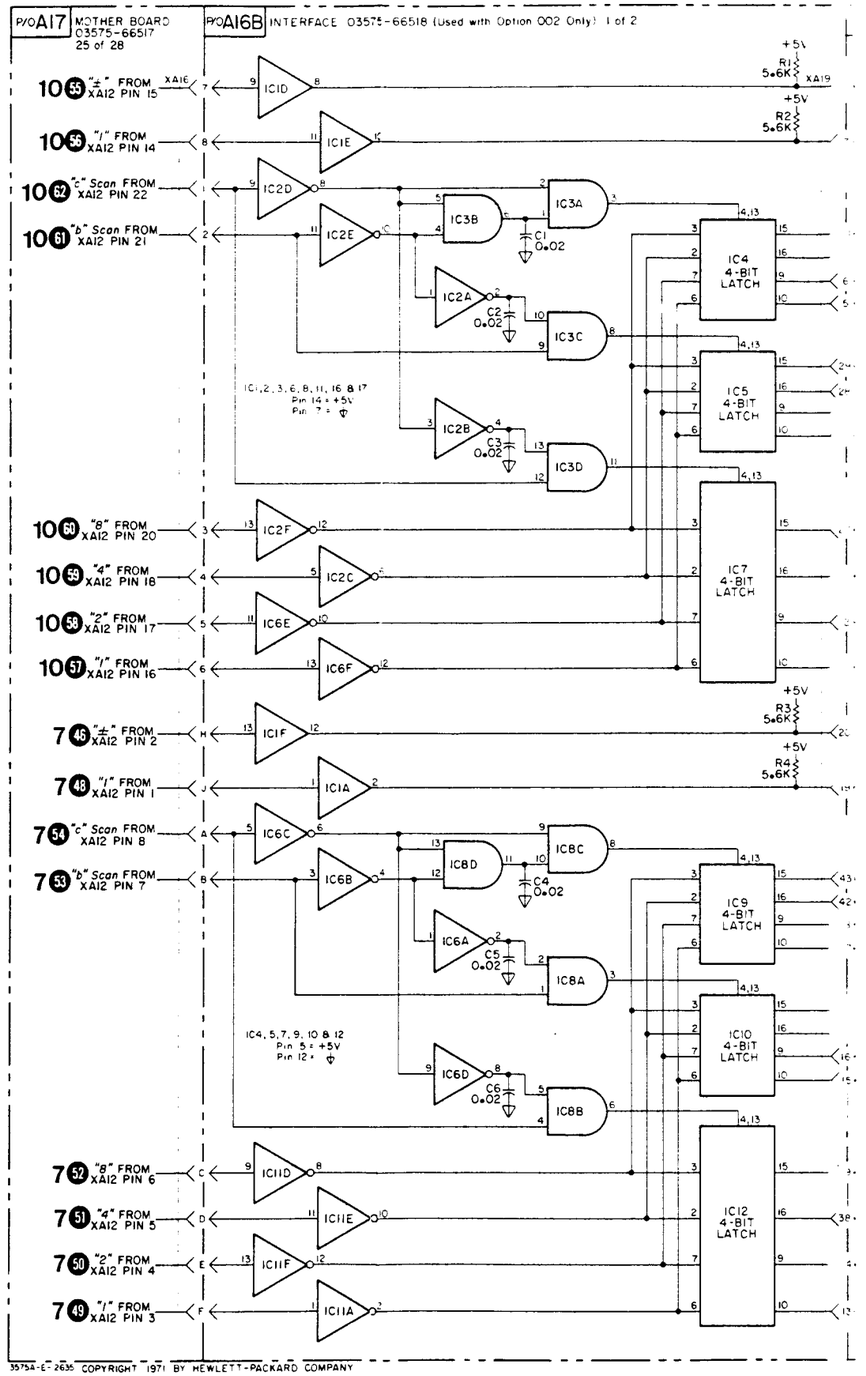


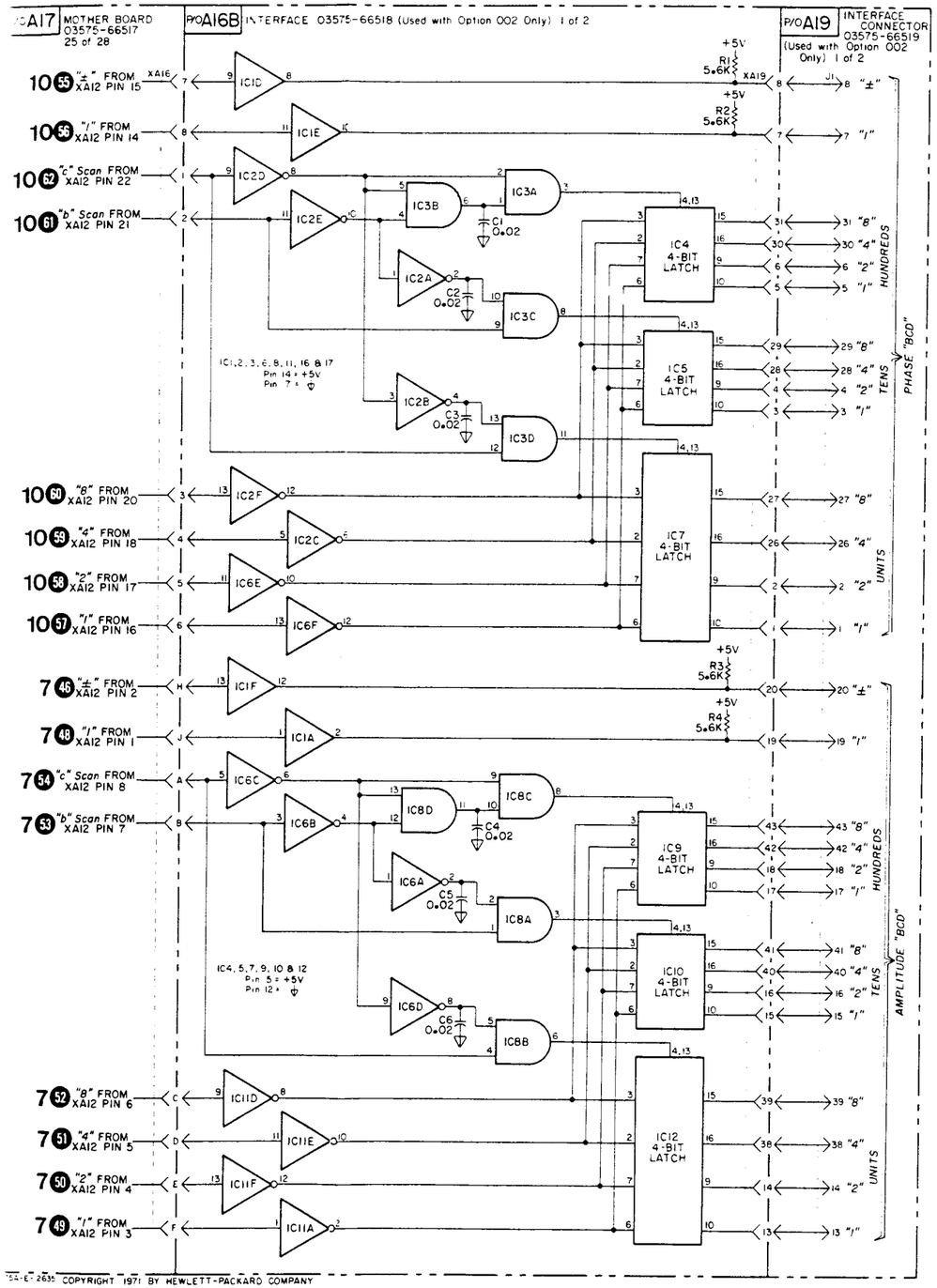

Figure 7-8. Panel Meter Connector (A12A/B) and Panel Meter (A20A/B, A21, A22) Schematics and Component Location Diagrams.




A16B

Part No. 03575-66518




P/O A17 MOTHER BOARD 03575-66517 25 of 28
P/O A16B INTERFACE 03575-66518 (Used with Option 002 Only) 1 of 2
P/O A19 INTERFACE CONNECTOR 03575-66519 (Used with Option 002 Only) 1 of 2
"±" FROM XA12 PIN 15
"1" FROM XA12 PIN 14
"c" Scan FROM XA12 PIN 22
"b" Scan FROM XA12 PIN 21
"8" FROM XA12 PIN 20
"4" FROM XA12 PIN 18
"2" FROM XA12 PIN 17
"1" FROM XA12 PIN 16
"±" FROM XA12 PIN 2
"1" FROM XA12 PIN 1
"c" Scan FROM XA12 PIN 8
"b" Scan FROM XA12 PIN 7
"8" FROM XA12 PIN 6
"4" FROM XA12 PIN 5
"2" FROM XA12 PIN 4
"1" FROM XA12 PIN 3
IC1, 2, 3, 6, 8, 11, 16 & 17 Pin 14 = +5V Pin 7 = ⏚
IC4, 5, 7, 9, 10 & 12 Pin 5 = +5V Pin 12 = ⏚
HUNDREDS
TENS
UNITS
PHASE "BCD"
AMPLITUDE "BCD"
COPYRIGHT 1971 BY HEWLETT-PACKARD COMPANY

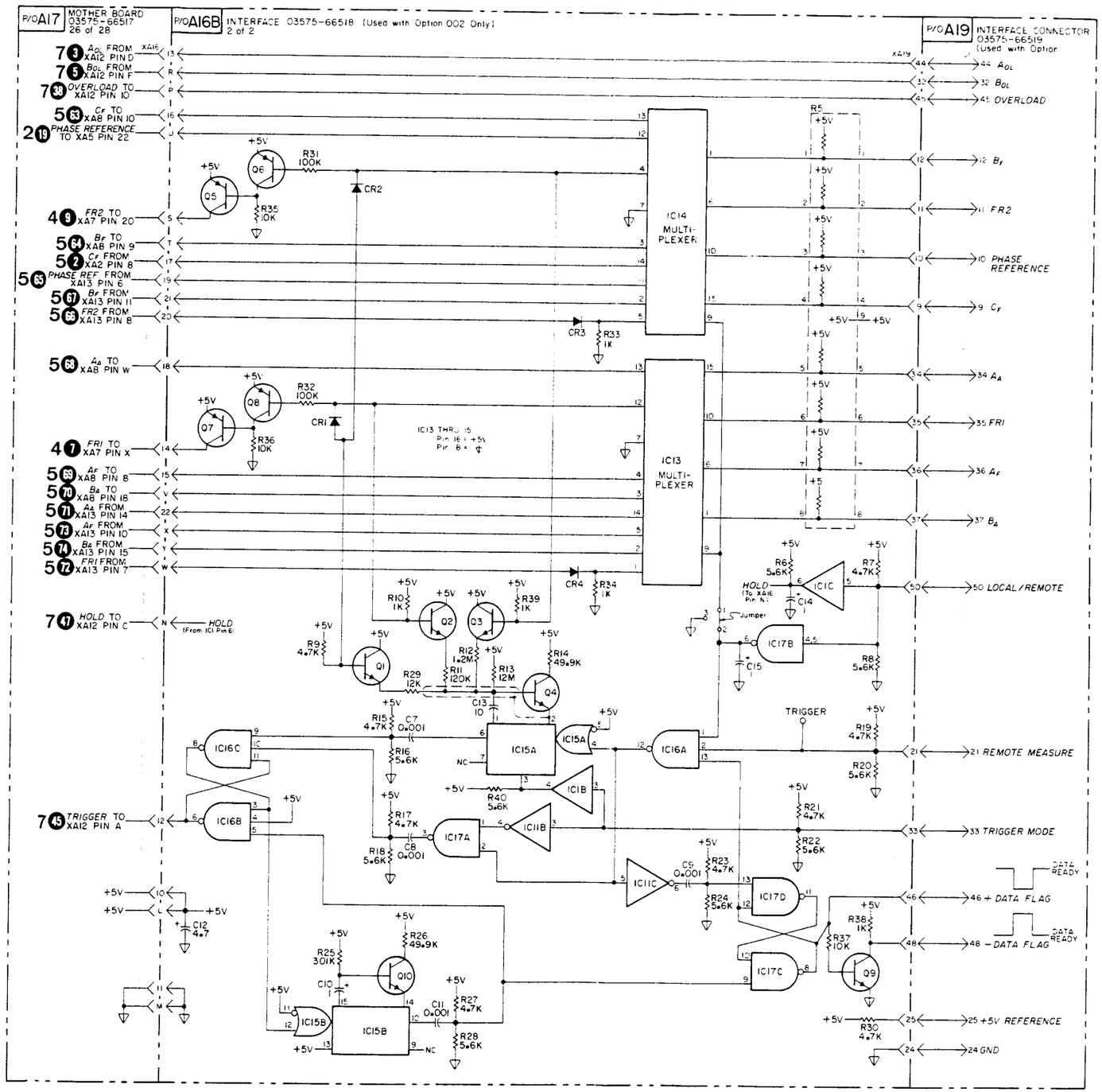
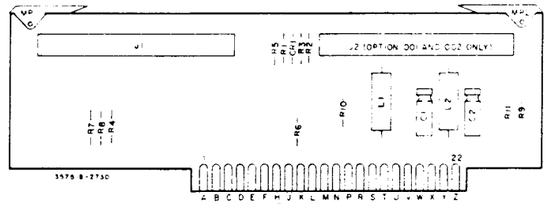
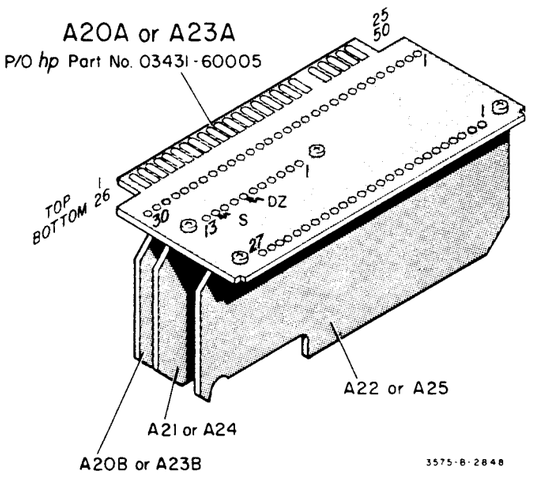

P/O A17 MOTHER BOARD 03575-66517 26 of 28
P/O A16B INTERFACE 03575-66518 (Used with Option 002 Only) 2 of 2
P/O A19 INTERFACE CONNECTOR 03575-66519 (Used with Option
$A_{OL}$ FROM XA12 PIN D
$B_{OL}$ FROM XA12 PIN F
OVERLOAD TO XA12 PIN 10
$C_F$ TO XA8 PIN 10
PHASE REFERENCE TO XA5 PIN 22
$B_F$ TO XA8 PIN 9
$C_F$ FROM XA2 PIN 8
PHASE REF. FROM XA13 PIN 6
$B_F$ FROM XA13 PIN 11
$FR2$ FROM XA13 PIN 8
$FR2$ TO XA7 PIN 20
$A_A$ TO XA8 PIN W
$FR1$ TO XA7 PIN X
$A_F$ TO XA8 PIN 8
$B_A$ TO XA8 PIN 18
$A_A$ FROM XA13 PIN 14
$A_F$ FROM XA13 PIN 10
$B_A$ FROM XA13 PIN 15
$FR1$ FROM XA13 PIN 7
HOLD TO XA12 PIN C
TRIGGER TO XA12 PIN A
IC13 THRU 15 Pin 16 = +5V Pin 8 = ⏚
IC13 MULTIPLEXER
IC14 MULTIPLEXER
HOLD (From IC1 Pin 6)
HOLD (To XA16 Pin N)
Jumper
TRIGGER
DATA READY
DATA READY
50 LOCAL/REMOTE
21 REMOTE MEASURE
33 TRIGGER MODE
46 + DATA FLAG
48 − DATA FLAG
25 +5V REFERENCE
24 GND

Figure 7-10. Interface Board (A16B) Schematic and Component Location Diagram.

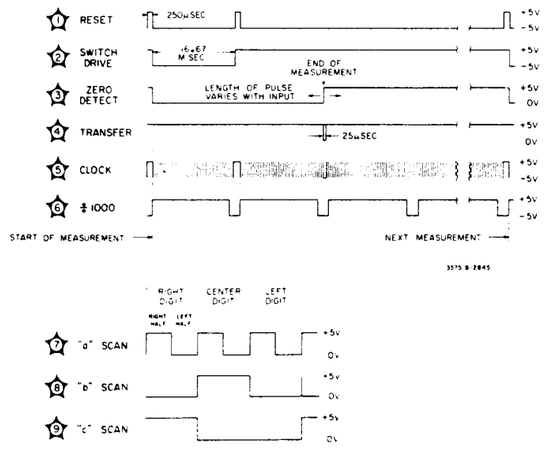


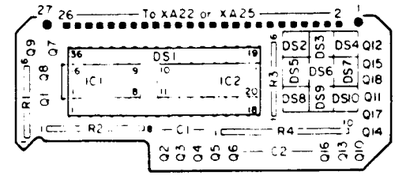

A12 A/B
*hp* Part No. 03575-66512
Rev B

A20A or A23A
P/O *hp* Part No. 03431-60005




3575-B-2848



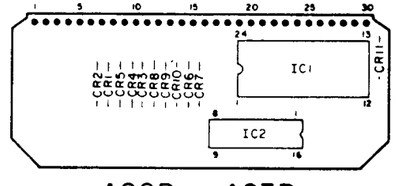




A22 or A25
*hp* Part No. 03431-66501
Rev A




A21 or A24
*hp* Part No. 03431-66513

3575-B-2849




A20B or A23B
P/O *hp* Part No. 03431-60005

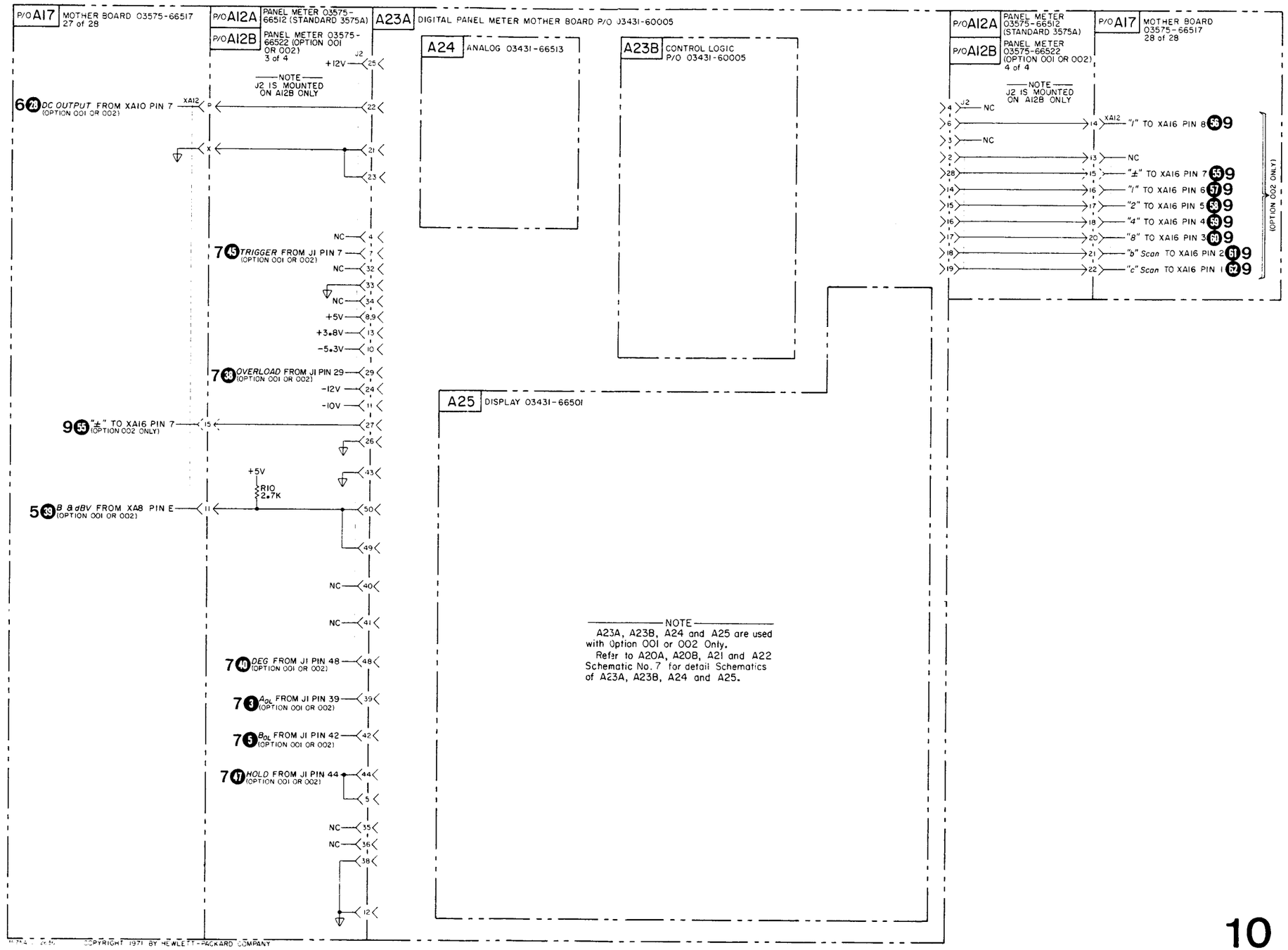

P/O A17 MOTHER BOARD 03575-66517 27 of 28
P/O A12A PANEL METER 03575-66512 (STANDARD 3575A)
P/O A12B PANEL METER 03575-66522 (OPTION 001 OR 002) 3 of 4
A23A DIGITAL PANEL METER MOTHER BOARD P/O 03431-60005
A24 ANALOG 03431-66513
A23B CONTROL LOGIC P/O 03431-60005
A25 DISPLAY 03431-66501
J2
+12V
NOTE
J2 IS MOUNTED ON A12B ONLY
6 28 DC OUTPUT FROM XA10 PIN 7 (OPTION 001 OR 002)
XA12
NC
7 45 TRIGGER FROM J1 PIN 7 (OPTION 001 OR 002)
+5V
+3.8V
-5.3V
7 38 OVERLOAD FROM J1 PIN 29 (OPTION 001 OR 002)
-12V
-10V
9 55 "±" TO XA16 PIN 7 (OPTION 002 ONLY)
R10 2.7K
5 33 B & dBV FROM XA8 PIN E (OPTION 001 OR 002)
7 40 DEG FROM J1 PIN 48 (OPTION 001 OR 002)
7 3 $A_{OL}$ FROM J1 PIN 39 (OPTION 001 OR 002)
7 5 $B_{OL}$ FROM J1 PIN 42 (OPTION 001 OR 002)
7 47 HOLD FROM J1 PIN 44 (OPTION 001 OR 002)
P/O A17 MOTHER BOARD 03575-66517 28 of 28
"/" TO XA16 PIN 8 56 9
"±" TO XA16 PIN 7 55 9
"/" TO XA16 PIN 6 57 9
"2" TO XA16 PIN 5 58 9
"4" TO XA16 PIN 4 59 9
"8" TO XA16 PIN 3 60 9
"b" Scan TO XA16 PIN 2 61 9
"c" Scan TO XA16 PIN 1 62 9
(OPTION 002 ONLY)
NOTE
A23A, A23B, A24 and A25 are used with Option 001 or 002 Only.
Refer to A20A, A20B, A21 and A22 Schematic No. 7 for detail Schematics of A23A, A23B, A24 and A25.
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Figure 7-11. Panel Meter Connector (A12A/B) and Panel Meter (A23A/B, A24, A25) Schematics and Component Location Diagrams.

CHANGE NO. 4

Section III Changes

Pages 3-13, 3-14:

Delete Paragraphs 3-75 through 3-91, Figures 3-10 and 3-11. Substitute Appendix C Paragraphs 3-75 through 3-91, Figures 3-10 and 3-11.

Section IV Changes

Pages 4-11 through 4-17:

Delete Paragraphs 4-65 to 4-101 and all tables and figures therein. Substitute Appendix C Paragraphs 4-65 to 4-105 and all tables and figures therein.

Section V Changes

Pages 5-9 to 5-10:

Delete Paragraphs 5-19 to 5-34. Substitute Appendix C Paragraphs 5-19 to 5-34.

Pages 5-19 and 5-20:

Delete Paragraphs 5-87 to 5-89. Substitute Appendix C Paragraphs 5-87 to 5-96.

Add Step 4 to Figure 5-5.

4. For repair or additional troubleshooting, remove two screws that fasten the Panel Meter boards together (MP42 Figure 6-2). Carefully and slowly unfold the Panel Meter. Do not bend the interconnecting wires further than necessary or more often than necessary.

Page 5-25/5-26:

Delete the Digital Panel Meter Troubleshooting Tree Figure 5-9. Substitute Appendix C Digital Panel Meter Troubleshooting Tree, Figure 5-9.

Section VI Changes

Page 6-13:

Delete A16C1

Change A16C10 to 0180-0291, C:fxd elect 1 $\mu$F 10% 35 VDCW

Page 6-14:

Delete A16R1, R2

Change A16R25 to 0757-0476, 301 K 1% 1/8 W

Delete Pages 6-15 and 6-16. Substitute Appendix C Pages C-53 & C-54.

Section VII Changes

Delete Schematic Numbers 7, 9 and 10. Substitute Appendix C Schematic Numbers 7, 9 and 10.

CHANGE NO. 5

Page 6-11: On A12A (1 Panel Meter)

Add A12L2, 9100-3337 (same as L1)

On A12B (2 Panel Meters)

Delete C12

Page 7-25/7-26:

Delete A12C12. Connect A12L2 inparallel with L1. (Parallel output goes to pins 8 and 9 of J1 and J2.)

Delete A12C12. Connect A12L2 in parallel with L1.

CHANGE NO. 6

Section VI Changes

Page 7-25/7-26:

Delete A12C12. Connect A12L2 in parallel with L1. (Parallel output goes to pins 8 and 9 of J1 and J2.)

**3-75. Local/Remote Control.** Remote control operation is selected by applying a continuous ground (or - 0.5 V to + 0.4 V) to the Local/Remote control line (J1 pin 50). When ground is applied to the Local/Remote line, the following things take place within the 3575A:

a. The front panel controls (except LINE switch) are disabled.

b. The remote control lines are enabled.

c. The internal sampling in both panel meters is disabled (external triggering must be used).

d. The external trigger and flag timing circuits are enabled.

e. The "Remote" (REM) annunciators on the panel meters illuminate.

**3-76. Remote Control Lines.** In the remote control mode, the 3575A Option 002 will accept parallel binary instructions applied to the remote control lines. Since internal storage is not provided, the control lines must be held at ground (or - 0.5 V to + 0.4 V) by the external controller whenever a "true" condition is required. When remote operation is selected without inputs to the remote control lines, the lines are held in a "false" condition by the internal logic circuitry. With all control lines false, the control settings are programmed as follows:

| | |
|---|---|
| AMPLITUDE B/PHASE | AMPLITUDE B |
| Voltage Range | 2 mV to 20 V (both channels) |
| FREQUENCY RANGE | 1 - 1 K |
| AMPLITUDE FUNCTION | B/A |
| PHASE REFERENCE | A |

**3-77. BCD Outputs.** The 3575A Option 002 is equipped with separate BCD outputs for the two panel meters. These outputs provide parallel BCD information that corresponds with the respective panel meter readings. The BCD outputs each consist of three 8-4-2-1 BCD-coded digits, a single-line overrange ("1") digit and a single-line polarity indicator. Unlike the remote control lines, the BCD outputs are always enabled and can be used in the local or remote control mode.

**3-78. Overload Outputs.** There are three overload indicator lines available at pins 32, 44 and 45 of the Interface connector. The $A_{ol}$ line (J1 pin 44) goes low when channel A is overloaded and the $B_{ol}$ (J1 pin 32) goes low when channel B is overloaded. The third line, labeled "overload" (J1 pin 45), goes low when either or both channels are overloaded. Since the overload outputs are not stored functions, they will automatically return to the "false" condition (+ 5 V) when the overload is removed.

**3-79. External Triggering and Flag Timing Sequence.** As previously indicated the internal sampling in both panel meters is disabled when ground is applied to the Local/Remote control line. This means that external triggering must be used to obtain sucessive meter readings or BCD outputs in the remote control mode.

3-80. In the 3575A Option 002, the external triggering circuit operates in conjunction with the flag timing circuit to allow adequate settling time, trigger the panel meters and provide a "data ready" flag to the external controller. The timing sequence is initiated by an external trigger pulse which is applied to the Remote Measure line (J1 pin 21). The duration of the timing sequence depends on the condition of the Trigger Mode line (J1 pin 33) which permits selection of two modes of operation: the Delayed Mode and Non-Delayed Mode.

*NOTE*

*The Remote Measure command must be delayed for at least 0.5 ms following any change that affects the programmed state of the instrument.*

**3-81. Delayed Mode.** When the Trigger Mode line is held in a "false" condition (open or + 2.4 V to + 5 V), the timing sequence is as shown in Figure 3-10. In Figure 3-10, the Remote Measure line is pulled low at T0 by the external controller. This initiates a variable delay period (determined by the Frequency Range setting) and sets the + and - Data Flags. At the end of the variable delay period (T1), the panel meters are triggered, initiating a 140 ms measurement period. At the end of the measurement period (T2), the Data Flags are reset to indicate that data is ready at the BCD outputs.

3-82. The total time required to obtain a reading (T0 to T2) is equal to 140 ms plus the variable delay period determined by the Frequency Range setting. The approximate *total* delay times for each frequency range are as follows:

| Frequency Range | Total Delay |
|---|---|
| 1 - 1 K | 33 sec. |
| 10 - 100 K | 3.5 sec. |
| 100 - 1 M | 0.7 sec. |
| 1 K - 13 M | 0.2 sec. |

3-83. The purpose of the variable delay in the timing sequence is to allow time for the instrument to stabilize before a reading is taken. Since the times allotted by the variable delay are maximum, the instrument will often stabilize before the end of the delay period. This depends on the change in input parameters or control settings prior to the Remote/Measure pulse. In some applications such as swept measurements where readings are taken after slight changes in input parameters, it may be desirable to speed up the measurement process by omitting the variable time delay. This can be accomplished by holding the Trigger

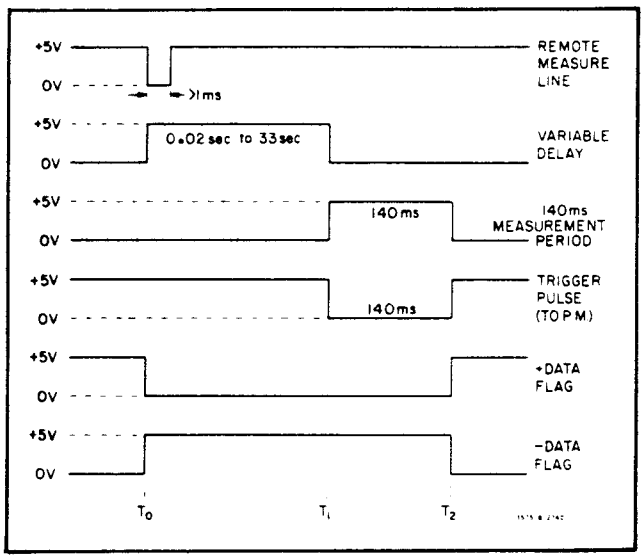



Figure 3-10. Flag Timing Delayed Mode.

Mode line in a "true" condition (gnd. or -0.5 V to +0.4 V). When the Trigger Mode line is grounded, the timing sequence is in the Non-Delayed Mode which operates as shown in Figure 3-11.

**3-84. Non-Delayed Mode.** In Figure 3-11, the Remote Measure line is pulled low at T0 by the external controller. This immediately triggers the panel meters and sets the + and - Data Flags. At the end of the 140 ms measurement period (T1), the Data Flags are reset to indicate that a reading has been taken.

**3-85. Remote Measure Rate.** As indicated in preceding paragraphs, the time required to obtain a reading depends on the selected mode of operation. In the Delayed Mode, the time varies from 0.2 second to 33 seconds as a function of the Frequency Range setting. In the Non-Delayed Mode, the time is fixed at approximately 140 ms. In order to obtain successive readings at a fixed rate, the time between Remote Measure pulses must be greater than the total delay period. For example, in the Non-Delayed Mode the 140 ms measurement period allows a maximum of 7 readings per second. In the Delayed Mode, 0.2 sec. allows 5 readings per second, 0.7 sec. allows 1 reading per second, 3.5 sec. allows 17 readings per minute and 33 seconds allows 1.8 readings per minute. In all cases, the Remote Measure pulse width must be greater than 1 ms and less than the total measurement period.

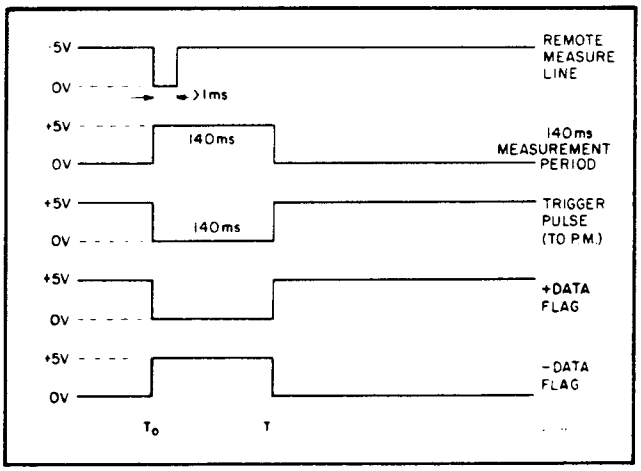



Figure 3-11. Flag Timing Non-Delayed Mode.

**3-86. Optional Control Scheme.** For some applications, it is convenient to control the instrument from the front panel and, at the same time, use external triggering and the flag timing functions. To allow this, a jumper is provided on the Interface Assembly (A16B, Schematic No. 9). With the jumper connected between points 1 and 2 (normal), grounding the Local/Remote control line disables the front panel controls, enables the remote control lines and enables the external trigger and flag timing circuits. With the jumper connected between points 1 and 3, the front panel controls are enabled and the remote control lines are disabled regardless of the condition of the Local/Remote control line. The external triggering and flag timing functions can then be used along with the front panel controls by grounding the Local/Remote control line.

## 3-87. USING A PRINTER.

3-88. The 3575A Option 002 output lines are compatible with -hp- Digital Recorder Models 5050B and 5055A. These printers can be connected directly to the 3575A Interface connector using the -hp- 562A-16C printer cable. Complete interfacing data is presented in Section II, Paragraph 2-29.

## 3-89. Triggering.

3-90. When using a printer, it is necessary to supply a ground-true (>1 ms) Remote Measure command to the 3575A each time a printout is required (see Paragraphs 2-30 and 3-80). The Remote Measure command sets the Data Flags and initiates the timing cycle within the 3575A. The printer receives a "print" command when the Data Flags are reset at the end of the timing cycle. Unless special arrangements have been made to ground the Trigger Mode line, the 3575A will remain in the Delayed mode and the "print" command will be transmitted at the end of the delay period. The delay period varies from approximately 33 seconds to 0.2 second as a function of the Frequency Range setting. If the Trigger mode line is grounded, the "print" command will be transmitted approximately 140 ms after the leading edge of the Remote Measure pulse.

## 3-91. Printout.

3-92. The -hp- Models 5050B and 5055A Digital Recorders provide a ten-column printout. The printer columns are numbered from right to left and the 3575A output data is printed as follows:

**4-65. Annunciator Logic (A8IC4 through IC6).** The fourth section of the Function Switching Assembly is the annunciator logic circuitry, A8IC4 through IC6. This circuit receives inputs from the $A_F$, $B_F$ and $C_F$ control lines and two additional inputs from the overload detectors on the Preamplifier Assemblies, A1 and A2. The purpose of the annunciator logic is to control the overload indicators and the various function indicators that appear on the Panel Meter display.

## 4-66. Output Filter (A9/A10 Schematic No. 6).

4-67. The Output Filter is a 4-pole low pass filter network controlled by the front panel FREQUENCY RANGE switch. The purpose of the filter is to integrate the amplitude or phase information before it is applied to the Panel Meter and ANALOG OUTPUT. The filter response is controlled by three lines, F, M and S which come from the Phase Control Filter, A7. The Output Filter network is identical to the Phase Control Filter network which is discussed in Paragraph 4-34.

4-68. It should be noted that the standard Model 3575A which has a single panel meter requires only one Output Filter. This filter is designated A9. Instruments that are equipped with dual panel meters (Options 001–003) require a separate Output Filter for each panel meter and, therefore, contain both A9 and A10 which are identical. Since the dual panel meter options are field installable, the standard Model 3575A has a vacant board slot and connector to permit the addition of A10.

## 4-69. Digital Panel Meter.

4-70. Refer to the Panel Meter Block Diagram (Figure 4-12) and Schematic No. 7 for the following discussion.

4-71. The Digital Panel Meter is a self-contained dc digital voltmeter which measures voltages within the range of - 1.999 Vdc to + 1.999 Vdc. The panel meter reading in dB, dBV or degrees, corresponds with the applied dc voltage. For example, an input of - 1.800 Vdc will produce a reading of - 180.0 degrees; an input of + 200 mVdc will produce a reading of + 20.0 degrees or + 20.0 dBV.

4-72. The Digital Panel Meter is divided into four major sections: the Analog section, the Counter/Display section, the Digital Controller section and the Decoder/Driver section. The Analog section uses a dual-slope integrator and a zero-detect comparator to perform a voltage to period conversion in response to sequential instructions from the Decoder/Driver section. The instructions are actually generated by the Digital Controller, but are processed by the Decoder/Driver before they are applied to the Analog section. The five instructions are: Charge, Discharge (+), Discharge (-), Measure and Auto Zero. The Measure instruction is given along with a Charge or Discharge instruction. The Auto Zero instruction is the complement of the Measure instruction and is given in the absence of a Charge or Discharge instruction.

4-73. To begin a measurement, the Charge instruction is given and the integrator within the Analog section charges toward the input voltage for 33 msec. At the end of the charge period, the Discharge (+) or Discharge (-) instruction is given and the integrator discharges at a fixed rate toward a reference voltage. The discharge period lasts for 66 msec. The selection of Discharge (+) or Discharge (-) depends on the polarity of the input voltage. If the input polarity is positive, the Discharge (-) instruction is given and the integrator discharges toward a negative reference voltage. Conversely, if the input polarity is negative, the Discharge (+) instruction is given and the integrator discharges toward

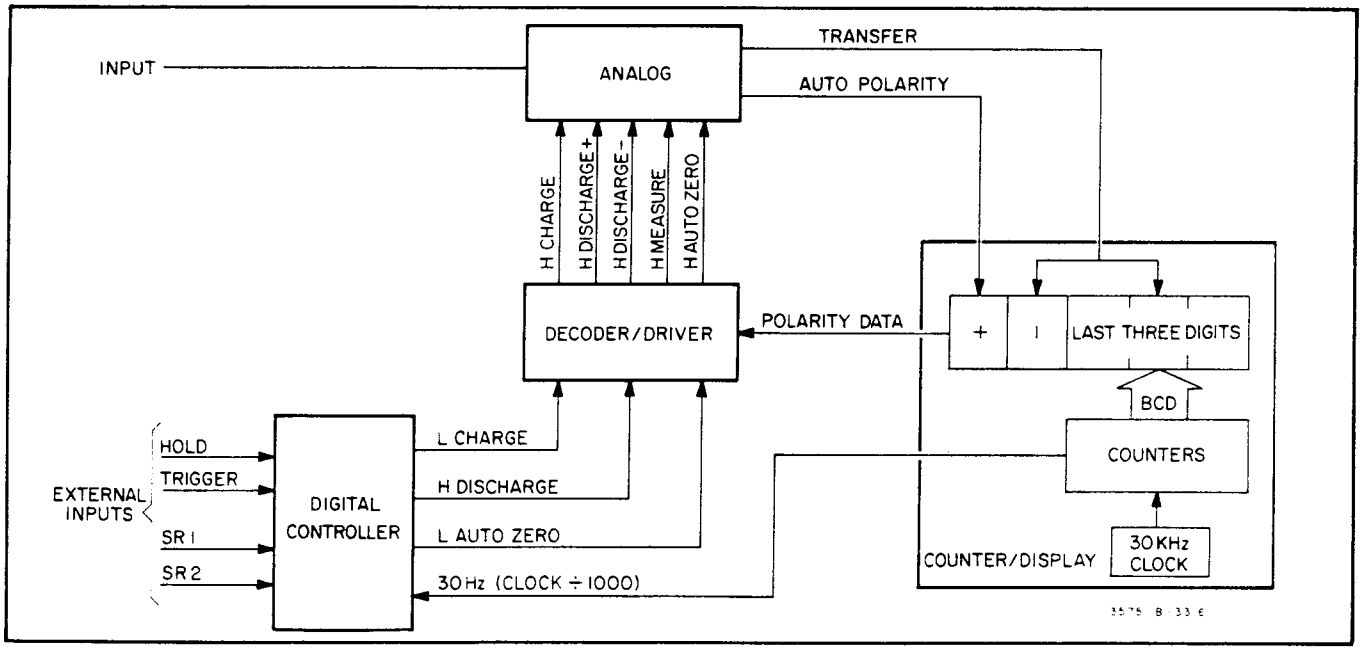



Figure 4-12. Panel Meter Block Diagram.

a positive reference voltage. Since the discharge rate is constant, the time required for the integrator to discharge to zero volts is proportional to the dc input voltage.

4-74. When the integrator discharges to zero volts, the zero-detect comparator within the Analog section changes states, generating a "Transfer" pulse which is applied to the Counter/Display section. The Transfer pulse transfers the 8-4-2-1 BCD-coded information from the counters to the last three digits of the display. At the beginning of the discharge period, the counters are set to 000 and during the first half (33 msec) of the discharge period, they are incremented from 000 to 999. If a Transfer pulse occurs during the first 33 msec, a number between 000 and 999 is transferred to the display. During the second half of the discharge period, the counters are again incremented from 000 to 999. In this case, however, a Transfer pulse will transfer the accumulated count to the displays and will also light the overrange ("1") indicator. The number transferred to the display will, therefore, be between 1,000 and 1,999. Due to the fixed discharge rate of the integrator and the frequency at which the counters are incremented, the number transferred to the display is always equal to the absolute value of the dc input voltage. Polarity information is transferred to the polarity flip-flop and the polarity indicator by way of the Auto Polarity line from the Analog section.

4-75. At the end of the 66 msec discharge period, the Measure instruction is removed and the Auto Zero instruction is applied. The Auto Zero instruction disables the analog circuits and charges capacitors which, during the measurement period, provide voltages that null out any dc offsets introduced by the active elements in the Analog section. The Auto Zero instruction lasts until the Digital Controller recycles to state 0 where a new measurement is initiated.

**4-76. Analog Section.** The Analog section is comprised of a dual-slope integrator (U101A), a zero-detect comparator (Q102–Q106), a level translator/inverter (Q211) and a pulse generator (U507C, U509D). The integrator and zero-detect comparator circuits pass through three states in the course of making a measurement. These states are determined by the conditions of seven FET switches (Q107–Q113) which, in turn, are controlled by instructions from the Decoder/Driver section. Table 4-5 is a truth table which indicates the conditions of the various FET switches for each of the five instructions.

4-77. Figure 4-13 illustrates the three states of the integrator and zero-detect comparator during the measurement cycle. The integrator begins a measurement with both inputs at zero volts. When the Charge instruction is given (Figure 4-13A), FET switch Q107 is closed, connecting the non-inverting input of the integrator to the unknown input voltage. If the input voltage is positive, the output of integrator U101A goes positive and integrator capacitor C104 charges in a positive direction through R105. If the input polarity is negative, the output of U101A goes negative and C104 charges in a negative direction through R105. Feedback for the integrator is provided by capacitor C103 which connects to the inverting input of U101A through source follower Q101B. Due to the extremely high input impedance of Q101B, very little current flows in the feedback path and C103, not having time to accumulate a charge, functions as a short circuit. With an input of + 1 Vdc applied to the Panel Meter, the voltage at the input of integrator U101A is approximately + 0.1 Vdc. This is due to the input divider consisting of R101 and R102. At the first instant when Q107 closes, capacitor C104 acts as a short circuit, making the gain of U101A equal to one. The output of U101A and the voltage at the junction of C104 and R105 then immediately jumps to + 0.1 Vdc. As C104 charges, the output of U101A rises to maintain + 0.1 Vdc at the junction of C104 and R105. Since a negligible amount of current flows in the feedback path, the current flowing through R105 is equal to the charge current flowing into C104. As long as the voltage drop across R105 is held constant, the current is constant and C104 charges at a linear rate. With an input of + 1 Vdc applied to the Panel Meter, C104 will charge to approximately 3 volts during the 33 ms charge period.

4-78. Note that integrator capacitor C104 is connected between the differential inputs of the zero-detect comparator. The zero-detect comparator functions as a X1000 amplifier and is used to detect the presence of a charge on C104. Due to the high gain of the comparator, even a slight charge on C104 will cause it to saturate in a positive or negative direction depending on the input polarity. The

**Table 4-5. Panel Meter Switching Logic.**

| INSTRUCTION | Q107 | Q108 | Q109 | Q110 | Q111 | Q112 | Q113 |
|---|---|---|---|---|---|---|---|
| Charge | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Discharge + | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Discharge - | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Measure* | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Auto Zero ** | 0 | 0 | 0 | 1 | 1 | 0 | 1 |

(1 = closed; 0 = open)

* The Measure instruction is given along with a Charge or Discharge instruction.

** The Auto Zero instruction is given in the absence of a Charge or Discharge instruction.

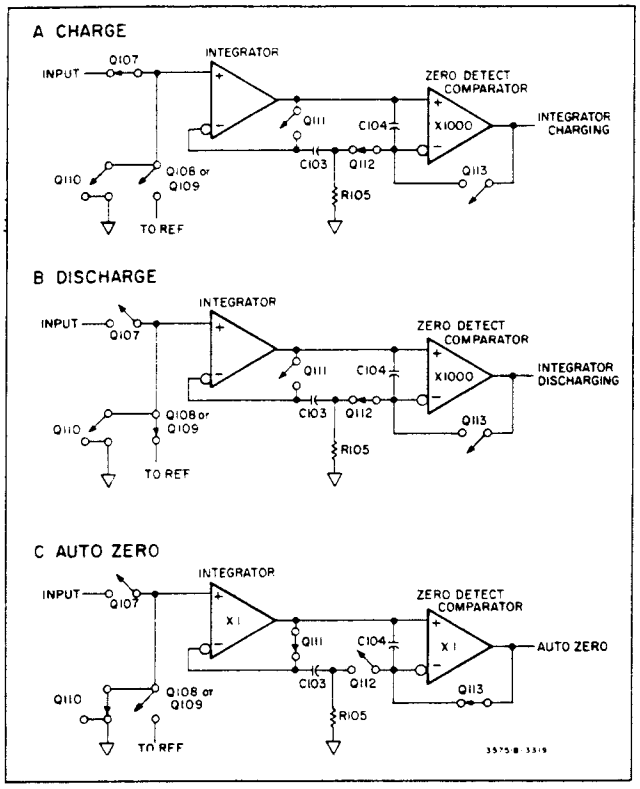



**Figure 4-13. Analog Circuit.**

output of the zero-detect comparator is applied to the level translator/inverter, Q211. The primary purpose of Q211 is to convert the level from the output of the comparator to a level that is compatible with the TTL logic used in succeeding stages. When the integrator capacitor is charged in a positive direction, the output of the zero-detect comparator goes positive, Q211 is gated on and the collector of Q211 drops to approximately + 0.2 Vdc. When the integrator capacitor is charged in a negative direction, the output of the comparator goes negative, Q211 is gated off and its collector rises to + 5 Vdc. The output of Q211 is applied to the pulse generator (U507C) and to the polarity flip-flop in the Counter/Display section.

4-79. At the end of the 33 msec charge period, a discharge instruction is given and the integrator discharges toward a reference voltage for 66 msec (Figure 4-13B). If the input voltage is positive, the Discharge (-) instruction is given. This closes FET switch Q109, placing a negative reference voltage at the input of the integrator. If the input voltage is negative, the Discharge (+) instruction is given. This closes FET switch Q108, placing a positive reference voltage at the input of the integrator. The positive or negative reference voltage at the input of the integrator causes integrator capacitor C104 to discharge. Due to the feedback configuration, the discharge rate of C104 is constant and the slope is linear. If the input voltage is ± 1.999 Vdc or less, capacitor C104 will discharge to zero volts before the discharge period is over. When C104 discharges through zero volts, the output of the zero-detect comparator changes polarity, producing a low-to-high or high-to-low transition on the collector of Q211. This transition is sensed by the pulse generator which, in turn, produces a 1 μsec, negative-going Transfer pulse which is applied to the Counter/Display section.

4-80. At the end of the 66 msec discharge period, the Auto Zero instruction is given for the remainder of the measurement cycle. When the Auto Zero instruction is applied, three things take place within the Analog section (Figure 4-13C):

a. The Measure instruction is removed, causing FET switch Q112 to open.

b. FET switch Q110 closes. This grounds the input of the integrator.

c. FET switches Q111 and Q113 close. This transforms the integrator and the zero-detect comparator into unity gain (X1) amplifiers.

4-81. With the input of the integrator grounded and the two circuits set for unity gain, the integrator output and the zero-detect comparator output should, in theory, be zero volts. In actual operation, however, both circuits introduce a slight amount of offset which could affect the accuracy of measurements. If the offsets were fixed, they could simply be calibrated out during the accuracy adjustments. Due to circuit aging and varying environmental conditions, however, the offsets change and frequent adjustments would be required to counteract them. A more convenient method, then, is to automatically cancel the offsets during each measurement cycle. This is accomplished by the Auto Zero mode.

4-82. In a unity gain amplifier, the offset voltage is simply the difference of potential that exists between the input and the output. In the case of the integrator, the input is at ground and the offset potential is between the output and ground. Since capacitor C103 (in series with R105) is connected between the output and ground, it charges to the integrator offset voltage. Capacitor C104 is connected between the two inputs of the zero-detect comparator. Since the output of the comparator is connected directly to the inverting input through FET switch Q113, C104 charges to the difference between the non-inverting input and the output which is the offset voltage. During the course of a measurement, the charges placed on C103 and C104 in the Auto Zero mode, cancel the offsets introduced by the integrator and zero-detect comparator, thereby zeroing the analog circuits.

**4-83. Counter/Display Section.** The Counter/Display section consists of a 30 kHz clock oscillator (U401), three decade counters (U302–U304), three decade display modules (U415–U417), an overrange flip-flop (U212B), a polarity flip-flop (U212A) and an overrange/polarity display module (U414). The 30 kHz clock oscillator continuously feeds pulses into the first decade counter, U302. Counter U302 counts from 0 through 9 and, on the tenth clock pulse, resets to 0 and passes a "carry pulse" to the

next decade counter, U303. Similarly, U303 counts from 0 to 9 and on the 100th clock pulse, resets to 0 and passes a carry pulse to the next decade counter, U304. Counter U304, in turn, counts from 0 to 9 and, on the 1000th clock pulse, resets to 0 and passes a carry pulse to the instruction counter (U505) in the Digital Controller section. The three counters, therefore, continuously count from 000 to 999, reset to 000 and increment the instruction counter. The 8-4-2-1 BCD output from each decade counter is applied to a decade display module. The decade display modules ignore the BCD inputs until they receive a Transfer pulse from the Analog section. Upon receipt of a Transfer pulse, the BCD code at the output of each decade counter is transferred to the associated display module where it is converted to decimal form and displayed until another Transfer pulse is received.

4-84. As previously indicated, the 66 msec discharge period is divided into two discharge periods each lasting 33 msec or 1,000 clock pulses. During the first half of the discharge period, the counters increment from 000 to 999 and are then reset to 000 on the 1,000th clock pulse. If the input voltage is ± 0.999 Vdc or less, the transfer pulse will occur during the first discharge period and the number transferred to the display will be within the range of 000 to 999. If the input voltage is between 1.000 Vdc and 1.999 Vdc, the transfer pulse will occur during the second half of the discharge period and again, the number transferred to the display will be between 000 and 999. In this case, however, the overrange ("1") indicator will be illuminated, yielding a corresponding display of 1000 to 1999. The information needed to light the overrange indicator is simply that a Transfer pulse has occurred during the second half of the discharge period. To obtain this information, the Discharge 2 instruction (L Discharge 2) from the Digital Controller section is applied to the "D" input of the overrange flip-flop (U212B) and the Transfer pulse is applied to the "Clock" input of the overrange flip-flop. When a transfer pulse occurs, the state of the "D" input is transferred to the "Q" output. During the first half of the discharge period, the "D" input is high and, if a Transfer pulse occurs, the "Q" output goes high and the overrange indicator does not light. During the second half of the discharge period, the "D" input is low and, if a Transfer pulse occurs, the "Q" output goes low causing the overrange indicator to illuminate.

4-85. To complete the display, the polarity information from the Analog section must be transferred to the polarity flip-flop (U212A) to light the + or - polarity sign. The polarity of the input voltage is indicated by a logic output from the level translator/inverter (Q211) in the Analog section. This output is labeled "Auto Polarity" and is connected to the "D" input of the polarity flip-flop, U212A. The "Clock" input of the polarity flip-flop is connected to the L Charge instruction line form the Digital Controller section. The L Charge line is low during the charge period. At the end of the charge period, the L Charge line goes high and the polarity information at the "D" input of the polarity flip-flop is transferred to the "Q" output. If the input polarity is positive, the "D" input will be low, the "Q" output will go low and the "$\overline{Q}$" output will go high.Conversely, if the input polarity is negative, the "D" input will be high, the "Q" output will go high and the "$\overline{Q}$" output will go low. Since the horizontal segment of the polarity sign is permanently grounded (R505) and is always illuminated, it is only necessary to light the vertical segment to obtain a + sign. If the input polarity is positive, the "$\overline{Q}$" output of the polarity flip-flop goes high causing the output of inverter/driver Q502 to go low and the vertical segment to illuminate. Note that the "Q" and "$\overline{Q}$" outputs from the polarity flip-flop are applied to the Decoder/Driver section. In the Decoder/Driver section, these outputs are used in conjunction with the Discharge instruction from the Digital Controller to produce the Discharge (+) or Discharge (-) instruction that is applied to the Analog section during the discharge period.

**4-86. Digital Controller Section.** The Digital Controller is a simple algorithmic state machine (ASM) which provides sequential instructions that are used to control the measurement process in the Digital Panel Meter. The Digital Controller section is comprised of a presettable binary instruction counter (U505), a four-line to ten-line decoder (U506) and associated logic circuitry. As previously indicated, the decade counters in the Counter/Display section continuously count from 000 to 999 and, on the 1,000th clock pulse, reset to 000 and pass a carry pulse to the instruction counter, U505. Each state of the instruction counter, therefore, lasts for 1,000 clock pulses or 33 msec.

4-87. The instruction counter is a fully synchronous 4-bit binary counter which can be preset to any number between 0000 (0) and 1111 (15). The instruction counter has four 8-4-2-1 binary-coded output lines, four 8-4-2-1 binary-coded input lines, a "Load" input line, a "Clear" input line and a "Clock" input line. All input and output lines except (L) Load and (L) Clear use positive true logic. Since the instruction counter is fully synchronous, the input lines have no effect until after a clock pulse is received. For example, when the Clear input line is low, the counter resets to 0000 (LLLL) after the next clock pulse. Similarly, when the Load input is low, the information on the four data input lines is transferred to the four output lines after the next clock pulse. Note that the "8" data input line is permanently grounded and is always a logical zero while the states of the "1", "2" and "4" data input lines are determined by the condition of the "Hold" line which is an external input to the Panel Meter. When the Hold line is high (no hold), the input code is equal to 4. When the Hold line is low, the input code is equal to 3. When the Load input line is low, the counter will, therefore, go to state 3 if a hold is applied and to state 4 if a hold is not applied.

4-88. The four 8-4-2-1 binary-coded output lines from the instruction counter are applied to a four-line to ten-line decoder, U506. The decoder converts the 4-bit input code into low true, mutually exclusive outputs which serve as instruction lines. Although ten lines are available at the output of the decoder, only four lines are actually used. These lines are Charge (State 0), Discharge 1 (State 1),

Discharge 2 (State 2) and Hold (State 3). The first three output lines, Charge, Discharge 1 and Discharge 2 are applied to NAND gate U510B. When all of these lines are high (not Charge, not Discharge), the output of U510B is low supplying the (L) Auto Zero instruction. The Auto Zero instruction is, therefore, always given in the absence of a Charge or Discharge instruction. The two discharge instructions, Discharge 1 and Discharge 2, are applied to Exclusive OR gate U507A. When either of the Discharge lines is low, the output of U507A is high, supplying the (H) Discharge instruction which is applied to the Decoder/Driver section. Since the Discharge 1 and Discharge 2 instructions each last for 33 msec, the (H) Discharge instruction lasts for 66 msec.

4-89. Figure 4-14 is a flow diagram showing the instruction sequence for the Digital Controller. Remember that each state of the controller lasts for 1,000 clock pulses or 33 msec. At the beginning of a measurement, the instruction counter is in State 0 and the Charge instruction is given. After 1,000 clock pulses, the counter is incremented to State 1 (Discharge 1) and, after 2,000 clock pulses, the counter is incremented to State 2 (Discharge 2). Note that the (L) Discharge 2 line is connected to one input of U208B which functions as a negative OR gate. When either input to U208B is low, the output is low making the Load input to the instruction counter low. Thus, in State 2 the next state of the instruction counter is determined by the state of the "Hold" input line. If the Hold line is low, the counter will go to State 3 (Hold) after the next clock pulse. If the Hold line is high, the counter will jump to State 4. First, consider the case where the Hold line is low and the counter goes to State 3. The Hold output (State 3) of U506 is applied to the remaining input of U208B making the Load input to the instruction counter low. This again means that the next state of the instruction counter is determined by the condition of the Hold input line. As long as the Hold input line is held low, the instruction counter will remain in State 3 and measurements will be inhibited until an external trigger is applied. When ground is applied to the external "Trigger" line, a trigger pulse is generated causing the "Q" output of the trigger flip-flop (U213A) to go high. This, in turn, causes the output of NAND gate U509B to go low, applying a low to the Clear input of the instruction counter. The Clear input line overrides the other input lines and the instruction counter will reset to State 0 on the next clock pulse. If the Hold line remains low, a new reading will be taken and the instruction counter will again stop when it reaches State 3. If the Hold line is high, the instruction counter will jump from State 2 to State 4. In State 4, the Digital Controller checks the condition of sample rate select line SR1. If SR1 is high, the instruction counter resets to State 0 on the next clock pulse. If SR1 is low, the instruction counter continues to increment until it reaches State 8. In State 8, the Controller checks the condition of sample rate select line SR2. If SR2 is high, the instruction counter resets to State 0 and begins a new measurement. If SR2 is low, the counter continues to increment to State 15 and then automatically resets to State 0. In the 3575A, SR1 is permanently grounded and SR2 is always high. The measurement cycle, therefore, lasts

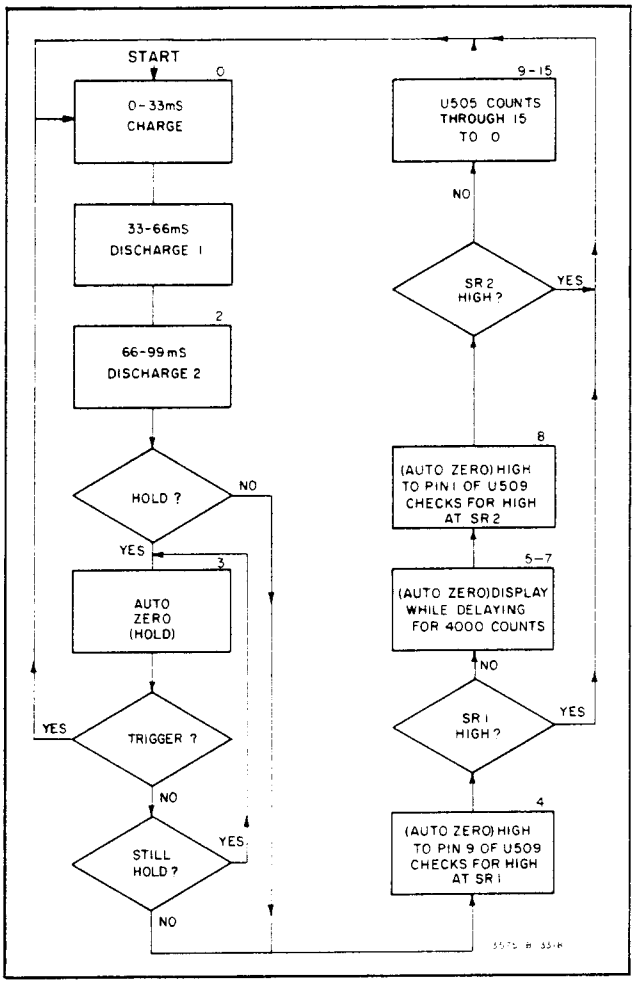



**Figure 4-14. Digital Controller Flow Chart.**

for approximately 264 msec making the sample rate approximately 4 per second. The "Hold" and "Trigger" lines are used only in 3575A Options 002 and 003 which are equipped for remote control operation. When Remote operation is selected, the Hold line is pulled low and an external trigger must be applied to initiate a measurement.

**4-90. Decoder/Driver Section.** The Decoder/Driver section is comprised of five individual circuits which receive instructions from the Digital Controller and, in turn, provide the output levels required to control the various FET switches in the Analog section.

4-91. The three circuits consisting of Q201/Q202, Q207/Q208 and Q209/Q210, provide the respective (H) Charge, (H) Auto Zero and (H) Measure instructions which control FET switches Q107 and Q110 through Q113. The two remaining circuits (Q203/Q204 and Q205/Q206) provide the (H) Discharge + and (H) Discharge - instructions which control FET switches Q109 and Q108, respectively. These two circuits are controlled by AND gates U208A and U208D which receive the (H) Discharge instruction from the Digital Controller and the (H) Pos. and (H) Neg. polarity indications from the polarity flip-flop, U212A.

**4-92. Additional Circuits.** Two additional circuits not previously mentioned in the functional description include the blanking circuit and the reference supplies. In addition, there are several outputs from the Panel Meter that are used in 3575A Options 002 and 003 that should be noted. Refer to Schematic No. 7 for the following discussions.

**4-93. Blanking Circuit (U213B, U510A, Q402).** The last three digits of the display (U405–U417), receive their positive supply voltage (+ 5 Vdc, Vcc) through pass transistor Q402. When Q402 is conducting, the display is illuminated; when Q402 is cut off, the display is blanked. Pass transistor Q402 is controlled by NAND gate U510A which, in turn, is controlled by two input lines. One input line connects to the "$\overline{Q}$" output of the overload flip-flop U213B and the other input line connects to the external "Digit Blank" input (pin 29)of the Panel Meter. When either of these lines is low, the output of U510A goes high, Q402 is cut off and the display is blanked. The "Digit Blank" input line is connected to the "Overload" output (pin B) of the Function Switching Assembly, A8 (Schematic No. 5). This line goes low when either channel is overloaded and will, therefore, cause the display to blank during an overload condition. Another condition that will cause the display to blank is if the voltage applied to the Panel Meter is greater than ± 1.999 Vdc. (This does not normally occur in the 3575A.) If the input to the Panel Meter is greater than ± 1.999 Vdc, a Transfer pulse will not occur during the discharge period. If a Transfer pulse has not occurred, the output of Exclusive OR gate U507B and the "D" input of U213B will be high at the end of the discharge period when U213B is clocked by a positive transistion on the L Discharge line. The high at the "$\overline{D}$" input will then be transferred to the "Q" output, the "Q" output will go low and the display will blank.

**4-94. Reference Supplies.** The reference supplies (shown in the upper right-hand portion of Schematic No. 7) are Zener-regulated power supplies that furnish the positive and negative reference voltages that are applied to the input of the integrator during the discharge period. Both of the reference supplies are adjustable, allowing the Panel Meter to be set for optimum accuracy with both positive and negative input voltages.

**4-95. Output Lines.** In the lower right-hand portion of Schematic No. 7, there are four outputs from the Panel Meter that are used in 3575A Options 002 and 003 to obtain parallel BCD outputs. These lines are Auto Polarity, Gated Clock, Reset and Flag. The Auto Polarity output connects to the (H) Pos. output of the polarity flip-flop, U212A. This line goes high if the input polarity is positive and low if the input polarity is negative. The Gated Clock output supplies clock pulses from the start of the discharge period until the Transfer pulse occurs. The number of pulses delivered during this period is equal to the Panel Meter reading. For example if the reading is 90.0 degrees, 900 output pulses will be delivered. When pulses are not being transmitted, the Gated Clock output is high. The Reset output connects directly to the (L) Charge instruction line from the output of U506. This line goes low when the instruction counter resets to State 0 at the beginning of a measurement and remains low during the charge period. The Flag output connects directly to the (L) Auto Zero instruction line from the output of U510B. This line is high during the charge and discharge periods and is low during the rest of the measurement cycle. Refer to Paragraph 4-99 for a description of how these lines are used to generate the BCD outputs.

## 4-96. Interface Assembly (A16B Schematic No. 9).

4-97. The Interface Assembly (A16B) is installed in place of the Interface Substitution Assembly (A16A) in instruments equipped with the remote programming and dual panel meter options (Options 002, 003). The purpose of the Interface Assembly is to provide the decoding, timing and switching logic required for the BCD outputs and remote controlled functions.

**4-98. BCD Output Circuits.** The BCD output circuitry shown on the left-hand side of Schematic No. 9 (IC1 through IC12) receives measurement data from the two panel meters and converts this data into parallel BCD outputs that are available at the rear panel Interface connector. The circuit in the upper portion of the schematic (IC2–IC4) converts the data from the right-hand (phase) panel meter, while the circuit in the lower portion of the schematic (IC5–IC7) converts the data from the left-hand (amplitude) panel meter. Since the two BCD output circuits are identical, the following description of the "phase" circuit applies to both circuits.

4-99. The BCD output circuit is comprised of three decade counters (IC2–IC4), an overrange flip-flop (IC1A) and associated logic circuitry. To begin a measurement, the Reset line (XA16 pin 2) from the panel meter goes low and remains low for 33 ms. This resets the decade counters to 000 and clears the overrange flip-flop. When the Reset line goes high, a series of pulses from the Gated Clock output of the panel meter are fed into the decade counters. Since the number of pulses is equal to the panel meter reading, the accumulated count at the end of the measurement cycle provides the required output data. If the count is greater than 999, counter IC2 passes a "carry" pulse to the overrange flip-flop which provides a single-line overrange indication. In 3575A Option 002, the high-true BCD outputs from the decade counters are applied to inverter gates (IC8, IC9) which provide low-true BCD outputs at the Interface connector. In Option 003 instruments, the inverter gates are replaced by non-inverting drivers which provide high-true BCD outputs at the Interface connector. Jumpers on the A16B board permit selection of high-true (P) or low-true (N) logic for the overrange and polarity output lines.

**4-100. Controller Section.** The controller section of the Interface Assembly is located in the upper right portion of Schematic No. 9. This section is comprised of two 4-bit multiplexers (IC13 and IC14) and a Local/Remote control circuit (IC17B, IC18B). Each multiplexer has eight inputs

and four outputs. Four of the inputs to each multiplexer come from the front panel controls and four come from the rear panel Interface connector, J1. The output lines go to the Function Switching Assembly (A8), the Phase Control Filter (A7), the Log Converter (A3/A4) and the Input Attenuators (A1/A2) to control the instrument functions. The multiplexers operate like 4-pole, double-throw switches where the four output lines are connected to either the front panel controls (Local) or the remote control lines (Remote). Switching is accomplished by applying a logical "1" (+5 V) or "0" (0 V) to IC13, IC14 pin 9 which connects to the Local/Remote line through NAND gate IC17B. With no input to the Local/Remote line or when local control is programmed by an external controller, the line is held positive causing the output of IC17B to go low. This disables the remote inputs to IC13 and IC14 and enables the inputs from the front panel controls. When ground is applied to the Local/Remote line, the output of IC17B goes high and control is transferred to the remote control lines. The eight remote control lines use ground true logic and are normally held in a "0" (False) condition by the pull-up resistors within R5.

4-101. Note that the local/remote line from the output of IC17B is also connected to a buffer/inverter stage, IC18B. When ground is applied to the Local/Remote line (Remote Control), the output of IC18B goes low supplying a "hold" to the panel meters. In the panel meters, the "hold" command disables the internal sampling and thereby inhibits measurements. In order to obtain meter readings or BCD outputs, it is then necessary to use external triggering. External triggering is accomplished by grounding the Remote/Measure line (J1 pin 21) which controls the timing circuits discussed in the following paragraphs. In some cases, it is desirable to use external triggering and, at the same time, control the instrument from the front panel. To accomplish this, a jumper is provided at the output of IC17B. When the jumper is connected between terminals 1 and 3 (gnd), the front panel controls remain operative and the remote lines that control front panel functions are disabled.

**4-102. Timing Circuits.** In the Remote Control mode, it is necessary to trigger the panel meters by applying a momentary ground to the Remote Measure line each time a meter reading or BCD output is required. Grounding the Remote Measure line sets the data flag and initiates a variable time delay which, in turn, triggers the panel meters and initiates the measurement cycle.

4-103. The external trigger and flag timing circuit is shown in the lower right-hand portion of Schematic No. 9 and in the Timing Circuits Functional Block Diagram, Figure 4-15. Refer to Figure 4-15 for the following discussion.

4-104. The timing circuits are comprised of a Trigger Flip Flop, A Flag Flip Flop, a Variable Delay, a 40 ms Delay and associated logic circuitry. Before the timing circuits can operate, remote operation must be selected by grounding the Local/Remote line. This disables the internal sampling in the panel meters and enables the timing circuits. With the Local/Remote line grounded, it is further necessary to momentarily ground the Remote Measure line to initiate the timing sequence and trigger the panel meters. Grounding the Remote Measure line causes the output of IC16A to go high. This, in turn, initiates the Variable Time Delay and sets the Flag Flip Flop. Note that the two flip flops are set and reset by a low (0) rather than a high (1). This is the reason for the inverter between the output of IC16A and the "set" side of the Flag Flip Flop. When a "set" command is applied to the Flag Flip Flop, the + Data Flag line goes low and the - Data Flag line goes high. Since the + Flag line ($\overline{Q}$) is fed back to the input of IC16A, the output of IC16A remains high until the Flag Flip Flop is reset. The Variable Delay is initiated by a Logical 1 at the output of IC16A and controlled by the two frequency

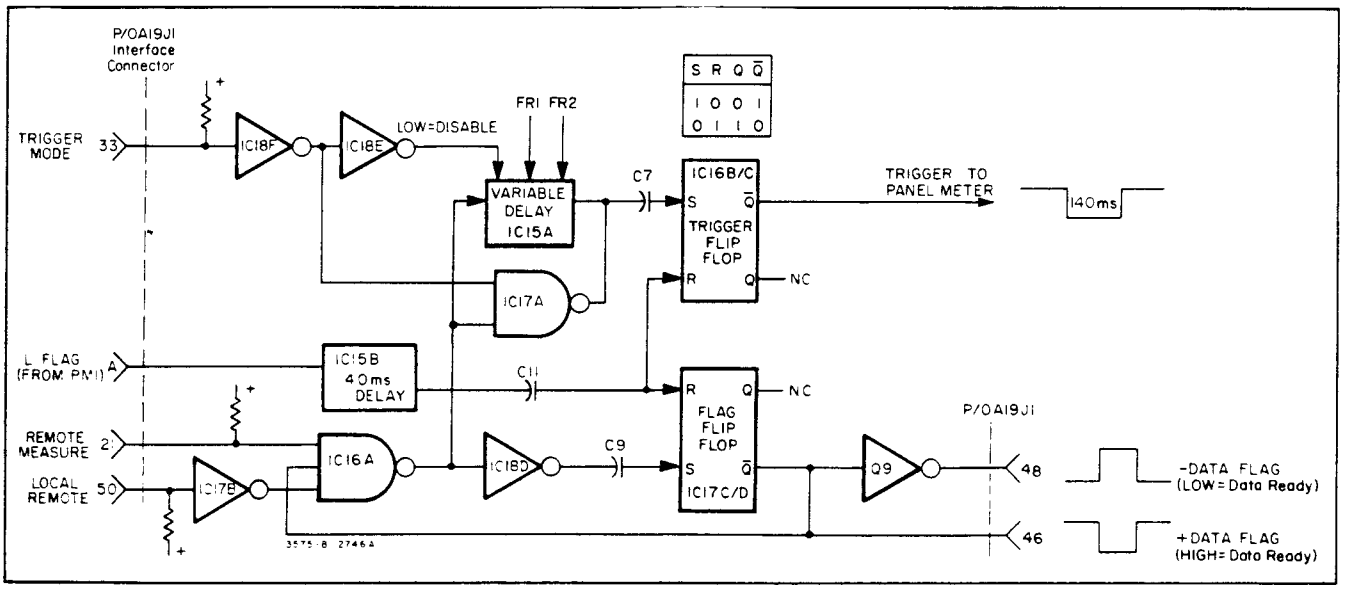



**Figure 4-15. Timing Circuits Functional Block Diagram.**

range lines, FR1 and FR2. Delay time is determined by the frequency range setting as indicated in Table 4-6. At the end of the delay period, the output of the Variable Delay circuit goes low applying a "set" command to the Trigger Flip-Flop. When "set", the $\overline{Q}$ side of the Trigger Flip-Flop goes low to trigger the panel meters. When the panel meters are triggered, the (L) Flag input from Panel Meter 1 goes high and remains high during the 100 ms measurement period. When the measurement is complete, the Flag line goes low, initiating the 40 ms time delay. When the 40 ms delay has elapsed, the output of the delay circuit goes low, applying a "reset" command to both flip-flops. This causes the panel meter Trigger line and the + Data Flag line to go high and the - Data Flag line to go low. Resetting the data flags indicates to an external controller that data is ready at the BCD outputs.

4-105. The purpose of the Variable Delay in the timing circuit is to ensure that the instrument has been given sufficient settling time before the data flags are returned. Since the actual settling time of the instrument is often less than the time provided by the Variable Delay circuit, the user may find it convenient to bypass the Variable Delay. This can be accomplished by applying a continuous ground to the Trigger Mode line. Grounding the Trigger Mode line disables the Variable Delay circuit and enables IC17A. When a momentary ground is applied to the Remote Measure line, the output of IC16A goes high, the output of IC17A goes low and the two flip-flops are set simultaneously. At the end of the 140 ms measurement cycle, both flip-flops are reset, the Trigger line goes high and the data flags are returned to their original states.

**Table 4-6. Variable Time Delays.**

| Frequency Range | Variable Delay |
|---|---|
| 1 Hz - 1 kHz | 33 sec. |
| 10 Hz - 100 kHz | 3.3 sec. |
| 100 Hz - 1 MHz | 0.42 sec. |
| 1 kHz - 13 MHz | 0.02 sec. |

## 5-19. ADJUSTMENT PROCEDURES.

5-20. This portion of Section V contains complete adjustment procedures for the Model 3575A Gain-Phase Meter. Included are power supply adjustments (Paragraph 5-25), Panel Meter Adjustments (Paragraph 5-29), Output Filter Zero Adjustments (Paragraph 5-33), Phase Detector Zero Adjustment (Paragraph 5-35), Current Source and Current Sink Adjustments (Paragraph 5-37), Amplitude Offset Adjustment (Paragraph 5-39), Log Amplifier (amplitude accuracy) Adjustments (Paragraph 5-41), Input Attenuator Adjustments (Paragraph 5-43) and High Frequency Phase Adjustments (Paragraph 5-45).

### 5-21. Test Equipment.

5-22. The test equipment required for the adjustments is listed in Table 5-1 and at the beginning of each adjustment procedure. If the recommended model is not available, any instrument that has specifications equal to or better than the required specifications can be used.

### 5-23. Test Point and Adjustment Location.

5-24. Test point and adjustment locations are shown in Figures 5-6 (top view) and 5-7 (panel meter). Figures 5-6 and 5-7 are located on a single fold-out at the end of Section V. All measurement points are either at the Analog Ouptuts or at designated pins of A7P1. Test connector A7P1 is a male PC connector located at the top of the Phase Control Filter Assembly, A7. For convenience when making test connections to A7P1, connect a 2X22-Pin female PC connector (-hp- Part No. 1251-1887) to A7P1 and use the pins of the female connector as test points. If the appropriate PC connector is not available, use the 2X22-Pin PC extender (-hp- 5060-5989) supplied with the instrument. All test measurements should be made with respect to circuit ground which is available at A7P1 pin X or at any point on the instrument chassis. All adjustments are easily accessible with the top cover of the instrument removed. It is not necessary to use PC extenders or remove any of the PC assemblies except when performing the Panel Meter Adjustments, Paragraphs 5-35 through 5-38.

### 5-25. + 12 V Reference Adjustment.

5-26. This adjustment sets the level of the + 12 Vdc power supply which serves as a reference for the other regulated supplies in the instrument.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)

a. Connect DC Digital Voltmeter to A7P1 pin 6.

b. Adjust A14R6 for + 12 V ± 3 mVdc.

### 5-27. Power Supply Voltage Checks.

5-28. The purpose of these checks is to verify that the non-adjustable power supply voltages are within design tolerances. If any of the voltages are out of tolerance, refer to the Power Supply Troubleshooting procedure (Paragraph 5-84).

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)

a. Measure the dc voltage at each test point listed in Table 5-4. At each test point, the dc voltage should be within the tolerance listed in the table.

**Table 5-4. Power Supply Checks.**

| Test Point | Supply | Tolerance |
|---|---|---|
| A7P1 Pin A | + 2 V (on A3) | + 1.985 V to + 2.015 V |
| A7P1 Pin B | + 2 V (on A4) | + 1.985 V to + 2.015 V |
| A7P1 Pin 3 | + 3.8 V | + 3.700 V to + 3.900 V |
| A7P1 Pin D | - 6 V (A) | - 5.980 V to - 6.020 V |
| A7P1 Pin 4 | - 6 V (B) | - 5.980 V to - 6.020 V |
| A7P1 Pin F | - 12 V | - 11.96 V to - 12.04 V |
| A7P1 Pin Y | - 5.3 V | - 5.200 V to - 5.400 V |
| A7P1 Pin 21 | + 5 V | + 4.980 V to + 5.020 V |

### 5-29. Panel Meter Adjustments (Standard Model 3575A).

*NOTE*

*Options 001-003: Refer to Paragraph 5-31*

5-30. The purpose of these adjustments is to set the dc accuracy of the Digital Panel Meter. Before proceeding with these adjustments, perform the Panel Meter Accuracy Check (Paragraph 5-9) to determine if adjustments are necessary.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)

a. Perform Steps a through i of the Panel Meter Removal procedure (Figure 5-5) to gain access to the panel meter adjustments.

b. Set the 3575A controls as follows:

DISPLAY .....PHASE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.

d. Set A5S1 to CAL 1. Set A6S1 to CAL 2.

e. Adjust A6R19 (Y ADJ) for a reading of + 1.8050 V on the Digital Voltmeter.

f. On the panel meter, adjust R212 (inside adjustment) for a panel meter reading that alternates between + 180.0 degrees and + 180.1 degrees.

g. Set A5S1 to CAL 2. Set A6S1 to CAL 1.

h. Adjust A5R40 (P1 ADJ) for a reading of - 1.8050 V on the Digital Voltmeter.

i. On the panel meter, adjust R211 (outside adjustment) for a panel meter reading that alternates between - 180.0 degrees and - 180.1 degrees.

j. This completes the panel meter adjustments. Reset A5S1 and A6S1 to NORMAL (4) and reassemble the instrument by reversing the procedure outlined in Figure 5-5. Perform the Output Filter Zero Adjustments (Paragraph 5-33), the Phase Detector Zero Adjustments (Paragraph 5-35) and the Current Source and Current Sink Adjustments (Paragraph 5-37) before using the 3575A in a phase measurement application.

### 5-31. Panel Meter Adjustments (Options 001–003).

5-32. The purpose of these adjustments is to set the dc accuracy of the panel meters. Before proceeding with these adjustments, perform the Panel Meter Accuracy Check (Paragraph 5-9) to determine if adjustments are necessary.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)

*NOTE*

*The following procedure outlines the steps required to adjust the right-hand (phase) panel meter. When the adjustments for the right-hand panel meter are completed, place the left-hand panel meter in the right-hand slot and repeat the procedure.*

a. Perform Steps a through i of the Panel Meter Removal procedure (Figure 5-5) to gain access to the panel meter adjustments.

b. Set the 3575A controls as follows:

AMPLITUDE B/PHASE .....PHASE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Connect DC Digital Voltmeter to ANALOG OUTPUT 2.

d. Set A5S1 to CAL 1. Set A6S1 to CAL 2.

e. Adjust A6R19 (Y ADJ) for a reading of + 1.8050 V on the Digital Voltmeter.

f. On the right-hand panel meter, adjust R212 (inside adjustment) for a panel meter reading that alternates between + 180.0 degrees and + 180.1 degrees.

g. Set A5S1 to CAL 2. Set A6S1 to CAL 1.

h. Adjust A5R40 (P1 ADJ) for a reading of - 1.8050 V on the Digital Voltmeter.

i. On the right-hand panel meter, adjust R211 (outside adjustment) for a panel meter reading that alternates between - 180.0 degrees and - 180.1 degrees.

j. Place the left-hand panel meter in the right-hand slot and repeat Steps d through i. When adjustments are completed for both panel meters, reset A5S1 and A6S1 to NORMAL (4), install the panel meters in their original slots and reassemble the instrument by reversing the procedure outlined in Figure 5-5. Perform the Output Filter Zero Adjustments (Paragraph 5-33), the Phase Detector Zero Adjustment (Paragraph 5-35) and the Current Source and Current Sink Adjustments (Paragraph 5-37) before using the 3575A in a phase measurement application.

### 5-33. Output Filter Zero Adjustments.

5-34. These adjustments null out any dc offsets introduced by the Output Filters, A9 and A10 (A10 is in Options 001–003 only).

RECOMMENDED TEST EQUIPMENT:

DC Voltmeter (-hp- Model 412A)

a. Connect DC Voltmeter to ANALOG OUTPUT 1.

b. Set the 3575A controls as follows:

DISPLAY* .....PHASE
AMPLITUDE FUNCTION ..... B/A
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to PHASE.

c. Set A5S1 and A6S1 to CAL 1.

d. Connect a short clip lead between A9TP1 and A9TP2. This grounds the input to the filter.

e. Adjust A9R27 for 0 V ± 0.05 mVdc at Analog Output 1.

f. Remove the clip lead. Leave A5S1 and A6S1 set to CAL 1 for the following procedure.

g. Options 001–003: Perform the following additional steps:

h. Connect DC Voltmeter to ANALOG OUTPUT 2.

i. Connect a short clip lead between A10TP1 and A10TP2.

j. Adjust A10R27 for 0 V ± 0.05 mVdc at Analog Output 2.

k. Remove the clip lead. Leave A5S1 and A6S1 set to CAL 1 for the following procedure.

### 5-35. Phase Detector Zero Adjustment.

5-36. This adjustment nulls out any dc offset introduced by the Buffer/Integrator in the Phase Detector.

RECOMMENDED TEST EQUIPMENT:

DC Voltmeter (-hp- Model 412A)

a. Connect DC Voltmeter to ANALOG OUTPUT 1.*

* Options 001–003: Connect DC Voltmeter to ANALOG OUTPUT 2. Set the AMPLITUDE B/PHASE switch to PHASE.

b. Set the 3575A controls as follows:

DISPLAY ..... PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Set A5S1 and A6S1 to CAL 1.

d. Adjust A5R31 (ZERO ADJ) for 0 V ± 0.1 mVdc at the Analog Output.

e. Leave A5S1 and A6S1 set to CAL 1 for the following procedure.

### 5-37. Current Source and Current Sink Adjustments.

5-38. These adjustments set the P1 and P2 Current Sources and the X and Y Current Sinks to produce the proper dc levels at the output of the Phase Detector. These are the primary phase accuracy adjustments in the instrument.

RECOMMENDED TEST EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)

a. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.*

* Options 001–003: Connect DC Digital Voltmeter to ANALOG OUTPUT 2. Set the AMPLITUDE B/PHASE switch to PHASE.

b. Set the 3575A controls as follows:

DISPLAY ..... PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

c. Set A5S1 to CAL 2. Set A6S1 to CAL 1.

d. Adjust A5R40 (P1 ADJ) for - 1.8 V ± 0.1 mVdc at the Analog Output.

e. Leave A5S1 set to CAL 2. Set A6S1 to CAL 2.

f. Adjust A6R19 (Y ADJ) for 0 V ± 0.1 mVdc at the Analog Output.

g. Leave A5S1 set to CAL 2. Set A6S1 to CAL 3.

h. Adjust A6R21 (X ADJ) for 0 V ± 0.1 mVdc at the Analog Output.

i. Leave A6S1 set to CAL 3. Set A5S1 to CAL 3.

j. Adjust A5R39 (P2 ADJ) for 0 V ± 0.1 mVdc at the Analog Output.

k. Reset A5S1 and A6S1 to NORMAL (4).

### 5-39. Amplitude Offset Adjustment.

5-40. This adjustment sets the dc operating point of the Summing Amplifier in the Function Switching Assembly, A8.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)*
DC Digital Voltmeter (-hp- Model 3450A)
50-Ohm Feed-Thru Termination (-hp- Model 11048C)

* A Test Oscillator such as the -hp- Model 651B can be used in place of the Frequency Synthesizer.

a. Connect 50-ohm output of Frequency Synthesizer, terminated in 50-ohm load, to the Channel B input of the 3575A. Connect the DC Digital Voltmeter to A7P1 pin 2 (Options 001, 002: Connect DVM to ANALOG OUTPUT 2).

b. Set the 3575A controls as follows:

DISPLAY* ..... AMPLITUDE
AMPLITUDE FUNCTION ..... B
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz

* Options 001–003: Set the AMPLITUDE B/PHASE switch to AMPLITUDE B.

c. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms) and frequency to 1 kHz.

d. Record the DVM reading: mVdc.

e. Connect the DC Digital Voltmeter to ANALOG OUTPUT 1.

f. Adjust A8R43 until the DVM indicates the value recorded in Step d ± 0.2 mVdc.

### 5-41. Log Amplifier Adjustments.

5-42. These adjustments set the dc bias, gain and symmetry of the Log Amplifier and Synchronous Rectifier in each input channel. These are the primary amplitude accuracy adjustments in the instrument.

RECOMMENDED TEST EQUIPMENT:

Frequency Synthesizer (-hp- Model 3320B)
DC Digital Voltmeter (-hp- Model 3450A)
Variable Attenuator (-hp- Model 355D)
50-Ohm Feed-Thru Termination (-hp- Model 11048C)

*NOTE*

*The following procedure is performed first for channel B and then again for channel A. The channel B adjustments are located on the channel B Log Converter board, A4. The channel A adjustments are located on the channel A Log Converter board, A3.*

a. Connect the 50-ohm output of the Frequency Synthesizer to the input of the Variable Attenuator (no termination required). Connect the output of the Variable Attenuator, terminated in 50-ohm load, to the Channel B input of the 3575A.

b. Set the 3575A controls as follows:

DISPLAY* ..... AMPLITUDE
AMPLITUDE FUNCTION ..... B
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz
PHASE REFERENCE ..... A

* Options 001–003: Set the AMPLITUDE B/PHASE switch to AMPLITUDE B.

c. Set the Frequency Synthesizer amplitude to + 19.03 dBm (2 V rms/50 ohms) and frequency to 10 kHz.

d. Set the Variable Attenuator to 80 dB.

e. Connect DC Digital Voltmeter to A3/A4TP1.

f. Adjust A1/A2 R40 (ZERO ADJ on A or B Preamp) for a DVM reading of 0 V ± 0.1 Vdc.

g. Connect DC Digital Voltmeter to A7P1 pin 22 (Channel B) or A7P1 pin z (Channel A).

h. Adjust R18 (LOG BIAS ADJ) for a DVM reading of 0 V ± 0.2 mVdc.

i. Connect DC Digital Voltmeter to ANALOG OUTPUT 1.

j. Adjust R29 (AMPL SYM ADJ) until the *absolute value* of the voltage at Analog Output 1 is *minimum* e.g., - 735 mVdc is less than - 740 mVdc.

k. Set the Variable Attenuator to 90 dB and repeat Step j.

l. Set the Variable Attenuator to 70 dB.

m. Center R32 (LOG GAIN ADJ).

n. Adjust R50 (LOG OFFSET ADJ) for - 640 mV ± 0.5 mVdc at Analog Output 1.

o. Set the Variable Attenuator to 0 dB.

p. Adjust R32 (LOG GAIN ADJ) for + 60 mV ± 0.5 mVdc at Analog Output 1.

q. Reset the Variable Attenuator to 70 dB.

r. Repeat Steps n through q until optimum adjustment is obtained.

s. Connect the output of the Variable Attenuator, terminated in 50-ohm load, to the Channel A input of the 3575A.

t. Set the 3575A AMPLITUDE FUNCTION switch to A.

u. Repeat Steps c through r for channel A. The channel A adjustments are located on A3.

### 5-43. Input Attenuator Adjustments.

5-44. These adjustments compensate the input attenuators so that minimum phase shift is introduced by the attenuators on the 2 mV - 20 V range.

RECOMMENDED TEST EQUIPMENT:
Frequency Synthesizer (-hp- Model 3320B)
Variable Attenuator (-hp- Model 355D)
(2) 50-Ohm Feed-Thru Terminations (-hp- Model 11048C)
Power Splitter (See Figure 5-1)

a. Connect test equipment as shown in Figure 5-2.

b. Set the 3575A controls as follows:

DISPLAY* ..... PHASE
Voltage Range ..... 0.2 mV - 2 V (both channels)
FREQUENCY RANGE .10 Hz - 100 kHz

Additional checks can be performed using the power supply data listed in Table 5-6. If any of the supply voltages are out of tolerance, troubleshoot the corresponding power supply or regulator circuit by checking for the dc voltages shown on the schematics.

*NOTE*

*All of the regulators on A14 are directly or indirectly referenced to + 12 Vdc. The + 12 Vdc reference must, therefore, be properly adjusted to establish the accuracy of the other supply voltages. In addition, all of the IC regulators on A14 use + 12 Vdc and - 12 Vdc and a failure in either of these supplies can affect the other supply voltages.*

**5-87. No Load Checks.** The Power Supply Assembly, A14, is equipped with separate input and output connectors to permit the supplies to be checked under no load conditions. The 2X10-pin connector on the left-hand side of A14 receives unregulated inputs from the raw supplies on A15. The 12-pin connector on the right-hand side of A14 outputs the regulated voltages from A14 to the main Mother Board Assembly, A17.

5-88. To check the supplies under no load conditions, proceed as follows:

a. Place A14 on a 2X10-pin PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

b. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

c. Using a DC voltmeter, measure the regulated output voltages at pins 4 through 10 of the 12-pin connector on A14. The dc voltages should be as follows:

| Pin | Voltage |
|---|---|
| 4 | + 5 V ± 0.02 Vdc |
| 5 | - 5.3 V ± 0.1 Vdc |
| 6 | - 6 V ± 0.02 Vdc |
| 7 | - 6 V ± 0.02 Vdc |
| 8 | + 3.8 V ± 0.1 Vdc |
| 9 | - 12 V ± 0.04 Vdc |
| 10 | + 12 V ± 3 mVdc * |

* Adjustable

**5-89. Troubleshooting the + 12 V and - 12 V Supplies.** Due to the interaction between the + 12 V and - 12 V supplies, it is sometimes difficult to isolate failures in these supplies. If difficulty is encountered, check suspected components with an ohmeter or transistor checker, replace A14IC1 and IC2 or isolate the trouble using an external dc source as outlined in the following procedure:

RECOMMENDED EQUIPMENT:

DC Digital Voltmeter (-hp- Model 3450A)
± 12 Vdc Variable Power Supply (-hp- Model 467A)

a. Check to be sure that the raw supply voltages are present at XA14A pins 9 (+ 19 Vdc) and B (- 19 Vdc).

b. Disconnect one end of A14R1.

c. Place A14 on a 2X10 PC Extender (-hp- 5060-5987). Leave the 12-pin output connector disconnected.

d. Connect a short clip lead between chassis ground and pins 11 and 12 of the 12-pin connector on A14.

e. Connect the DC Digital Voltmeter to pin 9 of the 12-pin connector on A14.

f. Apply + 12 Vdc from an external power supply to pin 10 of the 12-pin connector on A14.

g. The DVM reading should now be - 12 Vdc. If - 12 Vdc is present, leave the external power supply connected and troubleshoot the + 12 V regulator circuit by checking for the dc voltages shown on Schematic No. 8. If - 12 Vdc is not present, perform the following steps.

h. Disconnect the external power supply and reconnect A14R1. Disconnect one end of A14R8.

i. Connect the DVM to pin 10 of the 12-pin connector on A14.

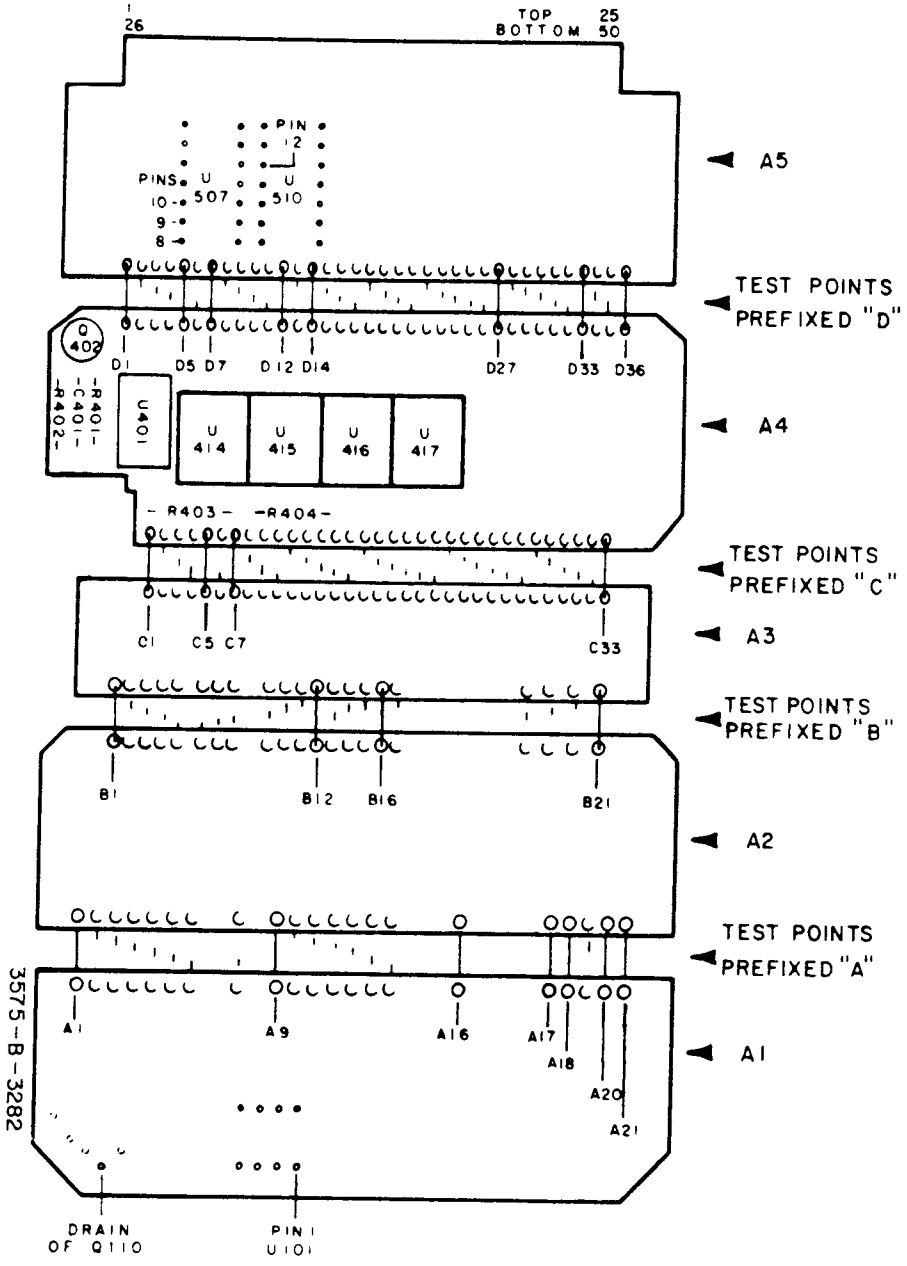
j. Apply - 12 Vdc from an external power supply to pin 9 of the 12-pin connector on A14.

k. The DVM reading should now be + 12 Vdc. If + 12 Vdc is present, leave the external power supply connected and troubleshoot the - 12 V regulator circuit by checking for the dc voltages shown on the schematics. If + 12 Vdc is not present, there are failures in both regulator circuits.

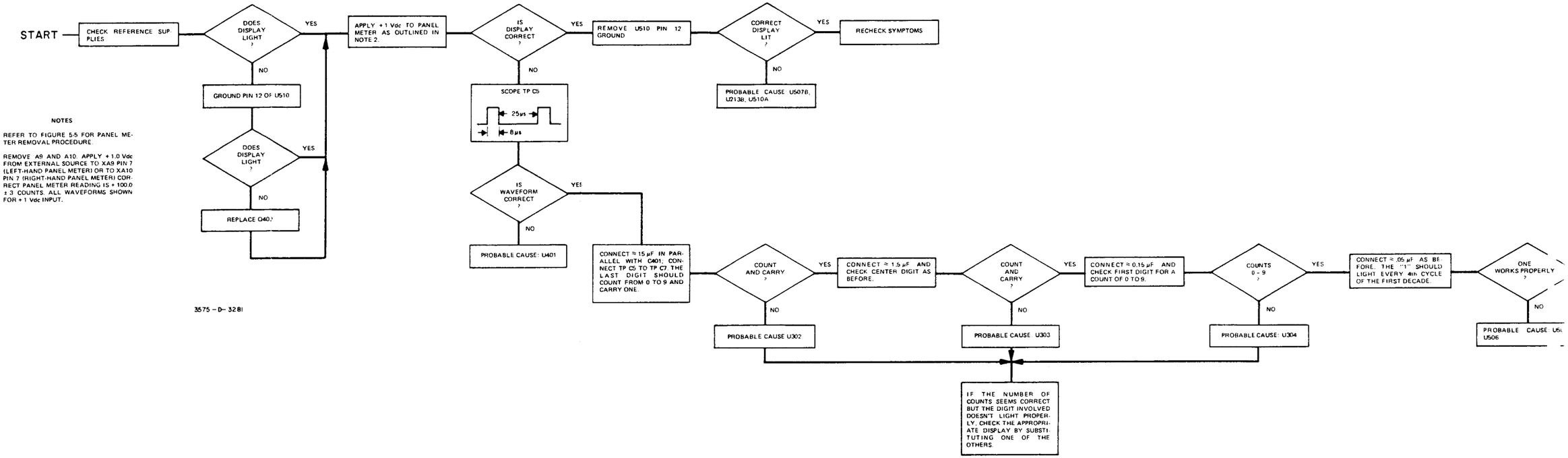
**Table 5-6. Power Supply Ratings.**

| Power Supply | Test Point | Voltage Limit | Ripple (p-p) | Line Regulation (115 V/230 V ± 10 %) | Nominal Load Current |
|---|---|---|---|---|---|
| + 12 V * | A7P1 Pin 6 | + 11.997 V to + 12.003 V | 1 mV | ± 1 mV | 180 mA |
| - 12 V | A7P1 Pin F | - 11.960 V to - 12.040 V | 1 mV | ± 1 mV | 180 mA |
| - 6 V (A) | A7P1 Pin D | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| - 6 V (B) | A7P1 Pin 4 | - 5.980 V to - 6.020 V | 1 mV | ± 0.1 mV | 200 mA |
| + 5 V | A7P1 Pin 21 | + 4.980 V to + 5.020 V | 1 mV | ± 0.1 mV | 1 A ** |
| - 5.3 V | A7P1 Pin Y | - 5.200 V to - 5.400 V | 1 mV | ± 0.1 mV | 350 mA |
| + 3.8 V | A7P1 Pin 3 | + 3.700 V to + 3.900 V | 3 mV | ± 0.2 mV | 300 mA |

* Adjustable (A14R6)
** Load increases to 1.5 A in Option 001 instruments and to 2 A in Option 002, 003 instruments.




DIGITAL PANEL METER (A20 OR A23)
-hp- PART NO. 5060-9132


START
CHECK REFERENCE SUPPLIES
DOES DISPLAY LIGHT ?
YES
NO
GROUND PIN 12 OF U510
DOES DISPLAY LIGHT ?
YES
NO
REPLACE Q402
APPLY +1 Vdc TO PANEL METER AS OUTLINED IN NOTE 2.
IS DISPLAY CORRECT ?
YES
NO
REMOVE U510 PIN 12 GROUND
CORRECT DISPLAY LIT ?
YES
NO
RECHECK SYMPTOMS
PROBABLE CAUSE U507B, U213B, U510A
SCOPE TP C5
25µs
8µs
IS WAVEFORM CORRECT ?
YES
NO
PROBABLE CAUSE: U401
CONNECT ≈ 15 µF IN PARALLEL WITH C401; CONNECT TP C5 TO TP C7 THE LAST DIGIT SHOULD COUNT FROM 0 TO 9 AND CARRY ONE.
COUNT AND CARRY ?
YES
NO
PROBABLE CAUSE U302
CONNECT ≈ 1.5 µF AND CHECK CENTER DIGIT AS BEFORE.
COUNT AND CARRY ?
YES
NO
PROBABLE CAUSE U303
CONNECT ≈ 0.15 µF AND CHECK FIRST DIGIT FOR A COUNT OF 0 TO 9.
COUNTS 0 - 9 ?
YES
NO
PROBABLE CAUSE: U304
CONNECT ≈ .05 µF AS BEFORE. THE "1" SHOULD LIGHT EVERY 4th CYCLE OF THE FIRST DECADE.
ONE WORKS PROPERLY ?
NO
PROBABLE CAUSE: U5
U506
IF THE NUMBER OF COUNTS SEEMS CORRECT BUT THE DIGIT INVOLVED DOESN'T LIGHT PROPERLY, CHECK THE APPROPRIATE DISPLAY BY SUBSTITUTING ONE OF THE OTHERS.

**NOTES**

1. REFER TO FIGURE 5-5 FOR PANEL METER REMOVAL PROCEDURE.
2. REMOVE A9 AND A10. APPLY +1.0 Vdc FROM EXTERNAL SOURCE TO XA9 PIN 7 (LEFT-HAND PANEL METER) OR TO XA10 PIN 7 (RIGHT-HAND PANEL METER) CORRECT PANEL METER READING IS +100.0 ±.3 COUNTS. ALL WAVEFORMS SHOWN FOR +1 Vdc INPUT.

3575 – D– 3281

MS

AND IT AS

COUNT AND CARRY ?

YES

NO

PROBABLE CAUSE: U303

CONNECT ≈ 0.15 µF AND CHECK FIRST DIGIT FOR A COUNT OF 0 TO 9.

COUNTS 0 - 9 ?

YES

NO

PROBABLE CAUSE: U304

IF THE NUMBER OF COUNTS SEEMS CORRECT BUT THE DIGIT INVOLVED DOESN'T LIGHT PROPERLY, CHECK THE APPROPRIATE DISPLAY BY SUBSTITUTING ONE OF THE OTHERS.

CONNECT ≈ 0.5 µF AS BEFORE. THE "1" SHOULD LIGHT EVERY 4th CYCLE OF THE FIRST DECADE.

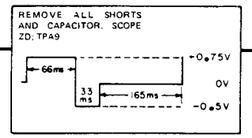
ONE WORKS PROPERLY ?

YES

NO

PROBABLE CAUSE: U505, U506

REMOVE ALL SHORTS AND CAPACITOR. SCOPE ZD; TPA9

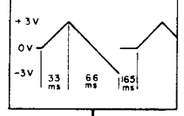



IS WAVEFORM CORRECT?

YES

NO

MONITOR PIN 1 OF U101A INTEGRATOR.



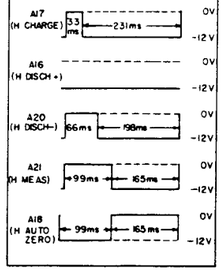

IS WAVEFORM CORRECT ?

YES

PROBABLE CAUSE Q102-Q104, Q106, Q113

NO

MONITOR TP A16-A21 (FET SWITCH DRIVE SIGNALS)



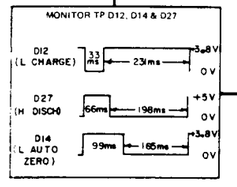

ARE ALL WAVEFORMS CORRECT ?

YES

PROBABLE CAUSE: U101A, Q101, Q107-Q112

NO

MONITOR TP D12, D14 & D27




ARE WAVEFORMS CORRECT ?

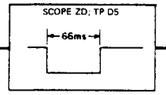
YES

PROBABLE CAUSE Q201-Q210 (CHECK CIRCUIT GENERATING INCORRECT SIGNAL)

NO

PROBABLE CAUSE U505, U506, U507A, U508

SCOPE ZD; TP D5



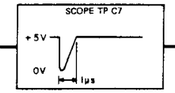

IS WAVEFORM CORRECT?

YES

NO

PROBABLE CAUSE: Q110

SCOPE TP C7




IS WAVEFORM CORRECT ?

YES

NO

PROBABLE CAUSE: U507C, U509D

CHECK BLANKING, TRIGGER & HOLD, POLARITY, ETC.

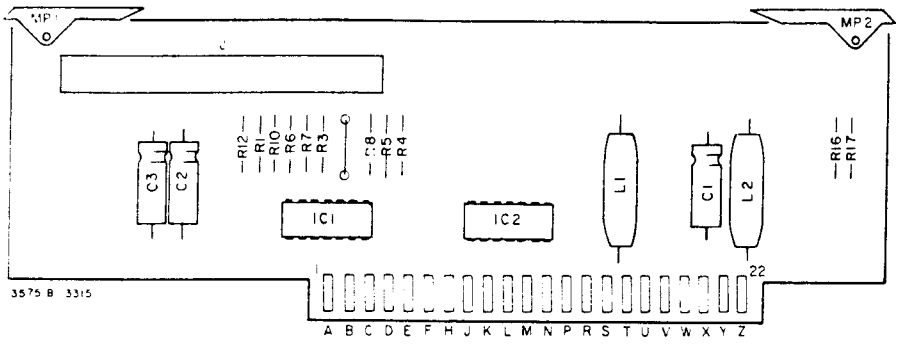
Figure 5-9. Digital Panel Meter Troubleshooting Tree.

Table 6-1. Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A20 | 5060-9132 | | PANEL METER | 28480 | 5060-9132 |
| C101 | 0160-0170 | 1 | C: FXD CER .22 UF 25 VDCW | 56289 | 5C98—CML |
| C102 | 0150-0046 | 1 | C: FXD .68 PF 500V | 78488 | TYPE GA |
| C103, C104 | 0160-3826 | 2 | C: FXD MET POLY .39 UF 10% 50 VDCW | 84411 | HEW—249 |
| C106—C400 | | | NOT ASSIGNED | | |
| C401 | 0140-0172 | 1 | C: FXD MICA 3000PF 1 | 14655 | obd |
| C402 THRU C500 | | | NOT ASSIGNED | | |
| C501, C502 | 0150-0071 | 1 | C: FXD CER .01 U | 14674 | CK12BX GMV |
| C503 | 0150-0071 | 1 | C: FXD CER 400 PF 1000V DCW 5% | 56289 | C016B102E401JS274 DH |
| CR101 | 1902-0072 | 1 | DIODE: BRKDN 7.87V 5% | 04713 | SZ 10939-158 |
| CR102 | 1910-0016 | 3 | DIODE: GE 100MA/0.85V 60 PIV | 93332 | D2361 |
| CR103 | 1901-0040 | 1 | DIODE: SI 30WV 50MA 2 PF 2NS | 01295 | PG512 |
| CR104 | 1902-0048 | 1 | DIODE: BRKDN 6.81V 5% | 04713 | SZ10939-134 |
| CR105 | 1901-0040 | | DIODE: SI 30WV 50MA 2 PF 2NS | 01295 | PG512 |
| CR106 | | | NOT ASSIGNED | | |
| CR107 | 1902-3149 | 1 | DIODE: BRKDN 9.09V 5% | 04713 | SZ 10939-170 |
| CR108 | 1902-0686 | 1 | DIODE: T.C.REF. 6.2V 2% | 04713 | SZ 12170 obd |
| CR109 THRU CR200 | | | NOT ASSIGNED | | |
| CR201 | 1901-0040 | | DIODE: SI 30WV 50MA 2 PF 2NS | 01295 | PG512 |
| CR202 | 1901-0518 | 1 | DIODE: HYBRID HOT CARRIER (2800) | 28480 | 1901-0518 |
| CR203 | 1902-3002 | 1 | DIODE: BRKDN 2.37V 5% | 04713 | SZ 10939-2 |
| DS1 THRU DS9 | 1990-0310 | 9 | DIODE: VISIBLE LIGHT EMITTER | 28480 | 1990-0310 |
| MP1 | 5040-5839 | 1 | HOUSING: ANNUNCIATOR | 28480 | 5040-5839 |
| MP2 | 03575-24301 | 1 | MASK: ANNUNCIATOR | 28480 | 03575-24301 |
| Q101, Q102 | 1855-0308 | 2 | TRANS: SI NPN | 17856 | DN 324 |
| Q103 | 1853-0086 | 1 | TRANS: SI PNP | 04713 | SPS3322 |
| Q104 | 1854-0071 | 9 | TRANS: SI NPN | 04713 | SPS5103 |
| Q105 | | | NOT ASSIGNED | | |
| Q106 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS5103 |
| Q107 | 1855-0081 | 3 | TRANS: JEDEC TYPE 2N5245 | 01295 | obd |
| Q108 | 1855-0386 | 3 | TRANS: JEDEC TYPE 2N4392 | 012040 | obd |
| Q109, Q110 | 1855-0081 | | TRANS: JEDEC TYPE 2N5245 | 01295 | obd |
| Q111 | 1855-0377 | 1 | TRANS: SI NPN | 17856 | FN2348 |
| Q112, Q113 | 1855-0386 | | TRANS: JEDEC TYPE 2N4392 | 12049 | obd |
| Q114 THRU Q200 | | | NOT ASSIGNED | | |
| Q201 | 1853-0020 | 5 | TRANS: SI PNP | 04713 | SPS 3609 |
| Q202 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| Q203 | 1853-0020 | | TRANS: SI PNP | 04713 | SPS 3609 |
| Q204 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| Q205 | 1853-0020 | | TRANS: SI PNP | 04713 | SPS 3609 |
| Q206 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| Q207 | 1853-0020 | | TRANS: SI PNP | 04713 | SPS 3609 |
| Q208 | 1584-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| Q209 | 1853-0020 | | TRANS: SI PNP | 04713 | SPS 3609 |
| Q210 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| Q211—Q401 | | | NOT ASSIGNED | | |
| Q402 | 1853-0093 | 1 | TRANS: SI PNP | 04713 | SS8041 |
| Q403—Q500 | | | NOT ASSIGNED | | |
| Q502 | 1854-0071 | | TRANS: SI NPN | 04713 | SPS 5103 |
| R101 | 0698-8312 | 1 | R: FXD FLM 499K OHM 1% | 91637 | CMF-55-1, T-2 |
| R102 | 0698-8313 | 1 | R: FXD FLM 52.3K OHM 1% | 91637 | CMF-55-1, T-2 |
| R103, R104 | 0698-3572 | 2 | R: FXD FLM 60.4K OHM 1% | 91637 | CMF-1/10-32, T-1 |
| R105 | 0698-4436 | 1 | R: FXD FLM 2.8K OHM 1% 1/8W | 14674 | C4 T-O obd |
| R106, R107 | 0698-3558 | 2 | R: FXD FLM 4.02K OHM 1% 1/8W | 28480 | 0698-3558 |
| R108 | 0757-0418 | 1 | R: FXD FLM 619 OHM 1% 1/8W | 14674 | C4 T-O obd |
| R109 | 0698-3495 | 1 | R: FXD FLM 866 OHM 1% 1/8W | 14674 | C4 T-O obd |
| R110 | 0684-2221 | 1 | R: FXD COMP 2200 OHM 10% 1/4W | 01121 | CB 2221 |
| R111 | 0684-1231 | 1 | R: FXD COMP 12K OHM 10% 1/4W | 01121 | CB 1231 |
| R112 | | | NOT ASSIGNED | | |
| R113 | 0698-3122 | 1 | R: FXD FLM 412 OHM 1% 1/8W | 14674 | C4 T-O obd |
| R114 | 0757-0417 | 1 | R: FXD FLM 562 OHM 1% 1/8W | 14674 | C4 T-O obd |
| R115 | 0698-4486 | 1 | R: FXD FLM 24.9K OHM 1% 1/8W | 19701 | MF4C T-O obd |
| R116, R117 | 0698-8316 | 2 | R: FXD FLM 49.9K OHM 1.0% 1/8W | 91637 | CMF-55-1 T-2 |
| R118 | 0698-8314 | 2 | R: FXD FLM 215K OHM 1% 1/8W | 91637 | CMF-55-1 T-2 |
| R119 | | | NOT ASSIGNED | | |
| R120 | 0698-8315 | 2 | R: FXD FLM 3.24K OHM 1% 1/8W | 91637 | CMF-55-1 T-2 |
| R121 | 0698-8314 | | R: FXD FLM 215K OHM 1% 1/8W | 91637 | CMF-55-1 T-2 |
| R122 | | | NOT ASSIGNED | | |
| R123 | 0698-8315 | | R: FXD FLM 3.24K OHM 1% 1/8W | 91637 | CMF-55-1 T-2 |
| R124 | 0698-4445 | 1 | R: FXD FLM 5.76K OHM 1% 1/8W | 14674 | C4 T-O obd |
| R125 THRU R202 | | | NOT ASSIGNED | | |
| R203 | 1810-0135 | 1 | R: NETWORK 0.125 W/PER | 56289 | 200C |
| R204 | 1810-0155 | 1 | R: NETWORK | 56289 | 200C |
| R205 THRU R209 | 0684-1031 | 5 | R: FXD COMP 10K OHM 10% 1/4W | 01121 | CB 1031 |

Table 6-1 Replaceable Parts(Cont'd)

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| R210 | 0684-4721 | 1 | R FXD COMP 4700 OHM 10% 1/4W | 01121 | CB4721 |
| R211 R212 | 2100-2061 | 2 | R VAR CER ELM 200 OHM 10% 1/2W | 80294 | 3329H-10-201 |
| R213 THRU R400 | | | NOT ASSIGNED | | |
| R401 | 0698-3160 | 1 | R FXD FILM 31.6K OHM 1% 1/8W | 14674 | C4T4O obd |
| R402 | 0757-0468 | 1 | R FXD FILM 130K OHM 1% 1/8W | 14674 | MC55 1-1 obd |
| R403 | 0684-1011 | 1 | R FXD COMP 100 OHM 10% 1/4W | 01121 | CB1011 |
| R404 | 0684-5611 | 1 | R FXD COMP 560 OHM 10% 1/4W | 01121 | CB5611 |
| R405 THRU R500 | | | NOT ASSIGNED | | |
| R501 THRU R505 | 0698-8318 | 5 | R FXD FILM 150 OHM .05% 1/8W | 80031 | MF4C T-2 obd |
| R506 | 0698-8317 | 1 | R FXD FILM 3.9K OHM .05% 1/8W | 80031 | MF4CT-2 obd |
| U101 | 1826-0111 | 1 | IC DUAL OP AMP SAME AS MC1458G | 04713 | SC25055GK obd |
| U102 THRU U207 | | | NOT ASSIGNED | | |
| U208 | 1820-0273 | 1 | IC DIGITAL | 04713 | SC8166PK |
| U209 THRU U211 | | | NOT ASSIGNED | | |
| U212 U213 | 1820-0077 | 2 | IC EQUIV TO SN7474N | 01295 | SN4354 |
| U214 THRU U301 | | | NOT ASSIGNED | | |
| U302 THRU U304 | 1820-0055 | 3 | IC TTL HIGH SPD DECADE CNTR | 01295 | SN4356 |
| U305 THRU U400 | | | NOT ASSIGNED | | |
| U401 | 1820-0207 | 1 | IC DIGITAL | 07263 | SL12895 |
| U402 THRU U413 | | | NOT ASSIGNED | | |
| U414 | 1990-0399 | 1 | IC NUMERIC DISPLAY LED | 28480 | 1990-0399 |
| U415 THRU U417 | 1990-0330 | 3 | IC NUMERIC DISPLAY LED | 28480 | 1990-0330 |
| U418 THRU U504 | | | NOT ASSIGNED | | |
| U505 | 1820-0713 | 1 | IC DIGITAL TTL + LOGIC | 01295 | SN24744 |
| U506 | 1820-0214 | 1 | IC TTL BCD TO DECIMAL DECODER | 01295 | SN9520 |
| U507 | 1820-0418 | 1 | IC DIGITAL | 04713 | SC8169PK |
| U508 | | | NOT ASSIGNED | | |
| U509 | 1820-0094 | 1 | IC DTL QUAD 2-INPUT GATE | 04713 | SC6903PK |
| U510 | 1820-0068 | 1 | IC TTL TRIPLE 3-INPUT POSITIVE GATE | 01295 | SN4343 |
| U511 | 1820-0328 | 1 | IC EQUIV TO SN7402N | 01295 | SN4467 |
| A21 A22 | | | NOT ASSIGNED | | |
| A23 (OPT 001 003 ONLY SAME AS A20) | 5060-9132 | | DIGITAL PANEL METER | 28480 | 5060-9132 |



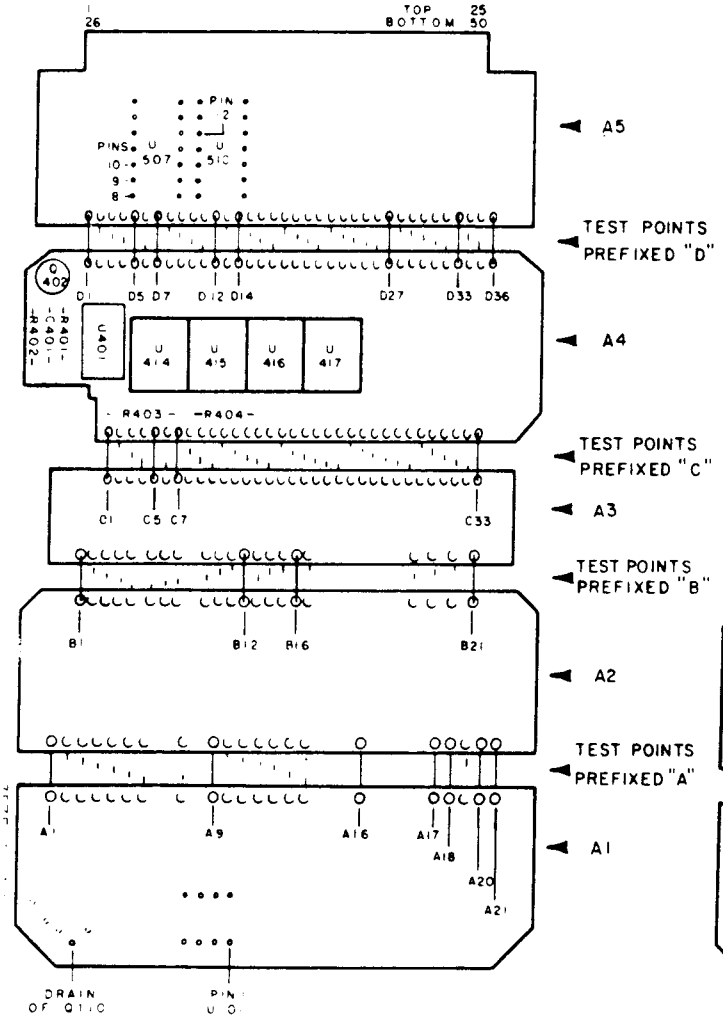

A12A

*hp* Part No. 03575-66530

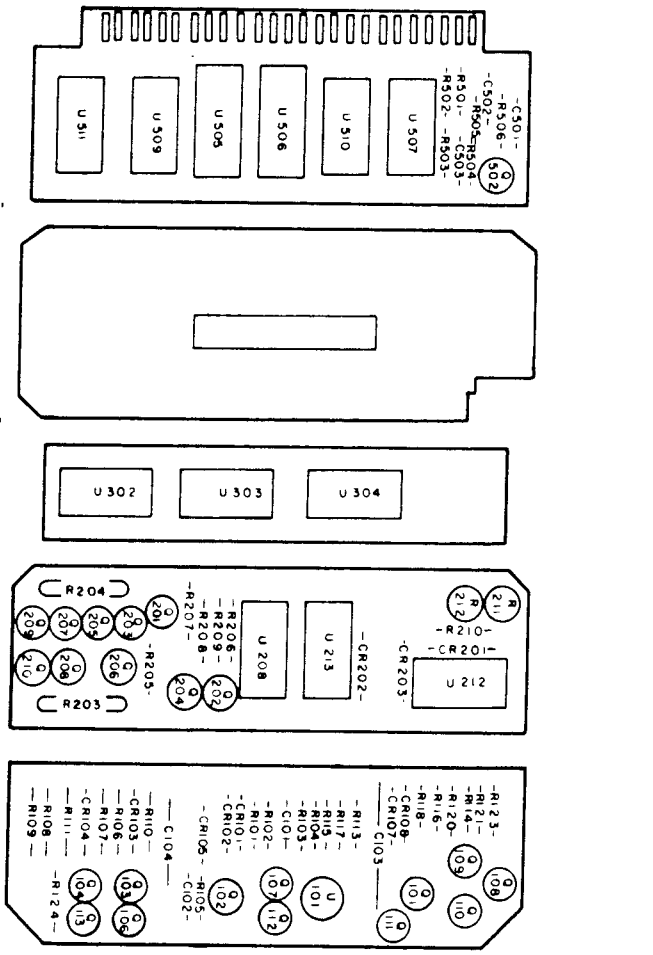
**CAUTION**

*Do not bend the wires (that connect the various parts of the digital panel meter) more than is necessary nor more often than is necessary. The digital panel meter was so designed that most of the test points are available at the front panel (prefixed "C" and "D") to minimize any necessity to flex the wires during troubleshooting.*

*After repair and calibration has been completed,* **gently and slowly** *refold the digital panel meter until it fits into its case.*




DIGITAL PANEL METER (A20 OR A23)
-hp- PART NO. 5060-9132




A20 or A23

*hp* Part No. 5060-9132

3575-B-3320

P/O A17 MOTHER BD 03575-66517 | P/O A12A PANEL METER BOARD 03575-66530 | A20 PANEL METER 5060-9132

6 (27) DC OUTPUT FROM XA9 PIN 7 — P/O XA12 M — P/O J1 27 — INPUT

INPUT COMMON — 9 — 2

5 (28) OVERLOAD FROM XA8 PIN B — 10 — 29 — L DIGIT BLANK (TO U510A PIN 2)

9 (28) OVERLOAD TO XA16 PIN P (OPTION 002,003 ONLY)

5 (3) AOL FROM XA8 PIN 1 — D — R10 100 — 16 — AOL — +5V

1 (3) AOL TO XA1 PIN 20

9 (3) AOL XA16 PIN13 (OPTION 002,003 ONLY)

(M) 5 DEG FROM XA8 PIN C — J — R8 100 — JUMPER — 46 — DEG — +5V

R7 100 — 19 — B/A — +5V

5 (13) B/A & dB FROM XA12 PIN2 — E — R6 100 — 18 — dB — +5V

5 (12) A FROM XA8 PIN 3 — H — R3 100 — 17 — A — +5V

9 (17) HOLD FROM XA16 PIN N — C — R1 100 — 40 — RMT — +5V

50 — L HOLD (TO U511 PINS 5&6)

5 (4) B FROM XA8 PIN 5 — L — R4 100 — 45 — B — +5V

5 (11) dBV FROM XA8 PIN D — K — R5 100 — 47 — dBV — +5V

5 (5) BOL FROM XA8 PIN A

15 (5) BOL XA2 PIN 2C

9 (5) BOL XA16 PIN R (OPTION 002, 003 ONLY)

F — R12 100 — 15 — BOL — +5V

## INTEGRATOR

R101 499K — C101 .22 — H CHARGE (FROM Q202)

R102 52.3K — +REF V (FROM Q108)

-REF V (FROM Q109)

INPUT COMMON (FROM Q110)

H AUTO ZERO (FROM Q208)

Q101A, Q101B, U101A, R103 60.4K, R104 60.4K, +12V, -12V

CR101 7.87V, CR102

Q111 — H AUTO ZERO — C102 68pF — C103 .39 — AUTO ZERO CAPACITOR

R105 2.8K — INPUT COMMON

Q112A — H MEASURE (FROM Q210)

C104 .39 — INTEGRATOR CAPACITOR

## ZERO DETECT COMPARATOR

R106 4.02K, R107 4.02K, CR103, Q103, CR105 CLAMP, +5V, R110 2.2K, Q104, CR104 6.8V, R111 12K, -12V

Q102A, Q102B, Q113 — H AUTO ZERO

CONSTANT CURRENT SOURCE

Q106 — R109 866, R108 619, R124 5760

## LEVEL TRANS.

A9 — R210 4.7K — D5 — Q211 — CR201

## PULSE GENERATOR

R501 150 — C501 .01 — U507C — C503 400pF — U509D — H DISCHARGE 1,2 (FROM U507A)

## 30KHz CLOCK

R402 30K, R40 31.6K — C401 3000pF — U401 — C5

30KHz — ZERO DET INTERRUPT — U208C

C7

## TRANSFER

+5V — U303 ÷10 — U304 ÷10 — U415 — U416 — DEC-1 — DEC-2

## OVERRANGE FF

U212B — L DISCHARGE 2 (FROM U506) — R403 100, R404 560

## AUTO POLARITY

C1 — R506 3.9K — Q502 — R504 150, R505 150 — L+, L± — U414

H± BLANK (TO PIN 26, GND)

## POLARITY FF

U212A — H POS (TO U208D) — U507B

## OVERLOAD BLANK

D7 — U213B — H COUNT TO TRANSFER (TO U510C) — L DISCHARGE 2 (FROM U506)

## BLANKING

D11 — U510A — L DIGIT BLANK (FROM PIN 29) — R503 150 — Q402 — +5V

D33 30Hz — U511D, U511B — L HOLD (FROM PIN 50)

## DECODER/DRIVER

L CHARGE (FROM U506)

A17 -3V — R203A 10K — H CHARGE — Q202, Q201 — R204A 10K — R205 10K — H NEG

A16 -3V — R203B 10K — H DISCHARGE + — Q204, Q203 — R204B 10K — U208A — D27 — H DISCHARGE 1,2, (FROM U507A)

A20 -3V — R203C 10K — H DISCHARGE - — Q206, Q205 — R206 10K, +2.63V, R207 10K — U208D — H POS (FROM U212A)

## DECODER / DRIVER

A21 -3V — R203D 10K — H MEASURE (TO Q112A) — Q210, Q209 — R204D 10K — R209 10K, +2.63V — D14 — L AUTO ZERO (FROM U510B)

A18 -3V — R203E 10K — H AUTO ZERO — Q208, Q207 — R204B 10K, R208 10K

NOTE

ALL WAVEFORMS SHOWN FOR INPUT OF +1.0VDC. REFER TO DIGITAL PANEL METER TROUBLESHOOTING TREE (FIG. 5-9) FOR DETAILS.

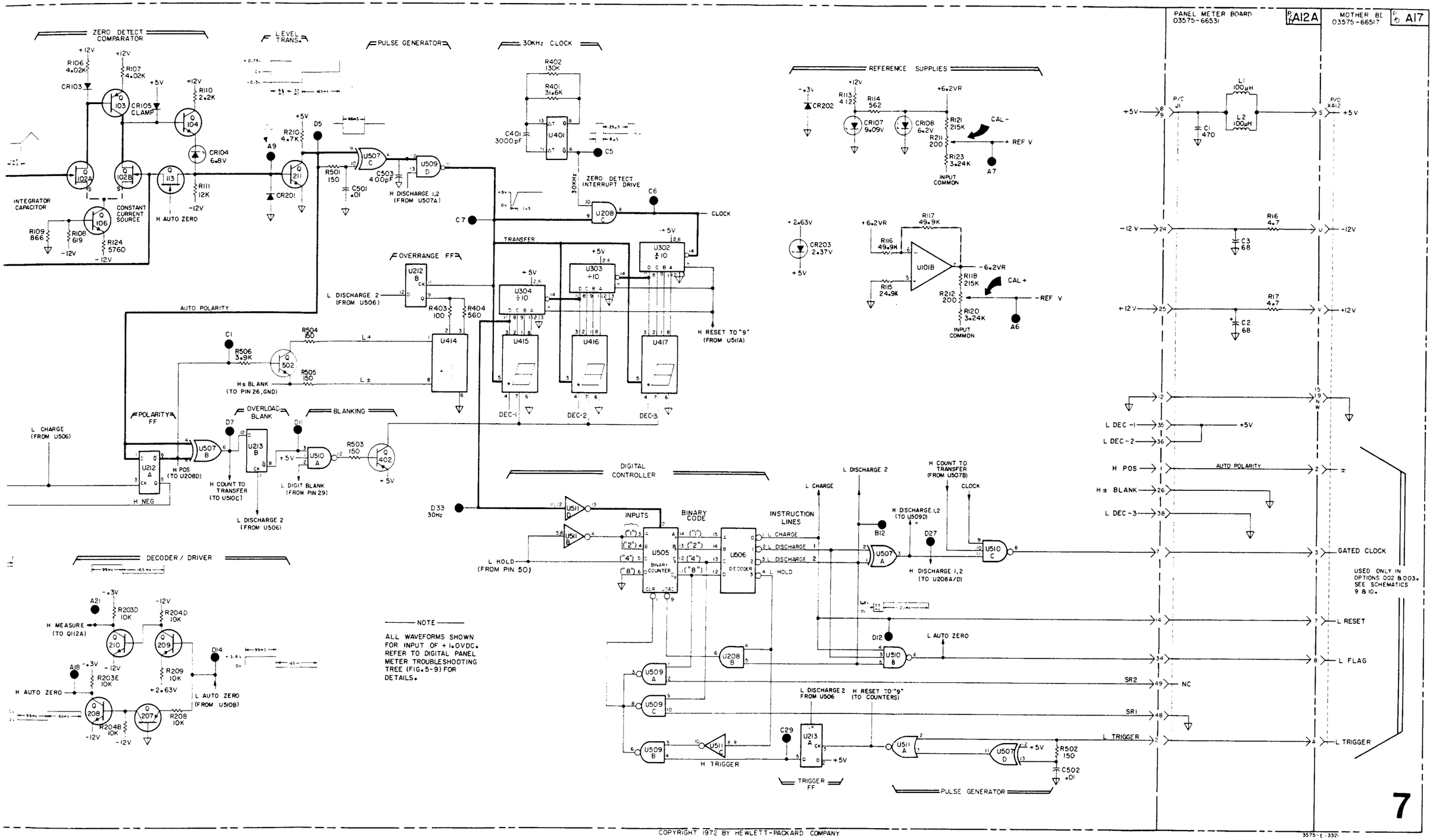
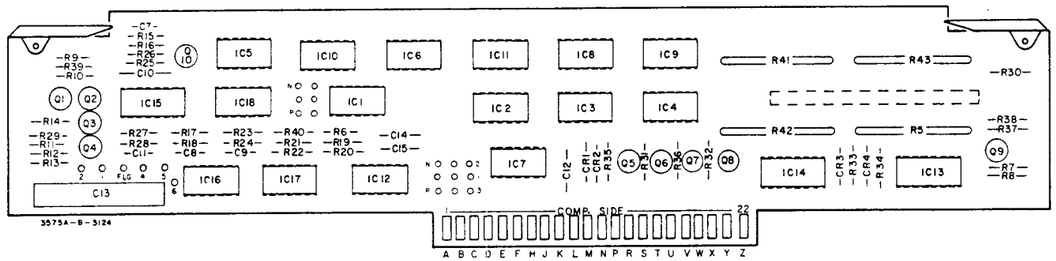


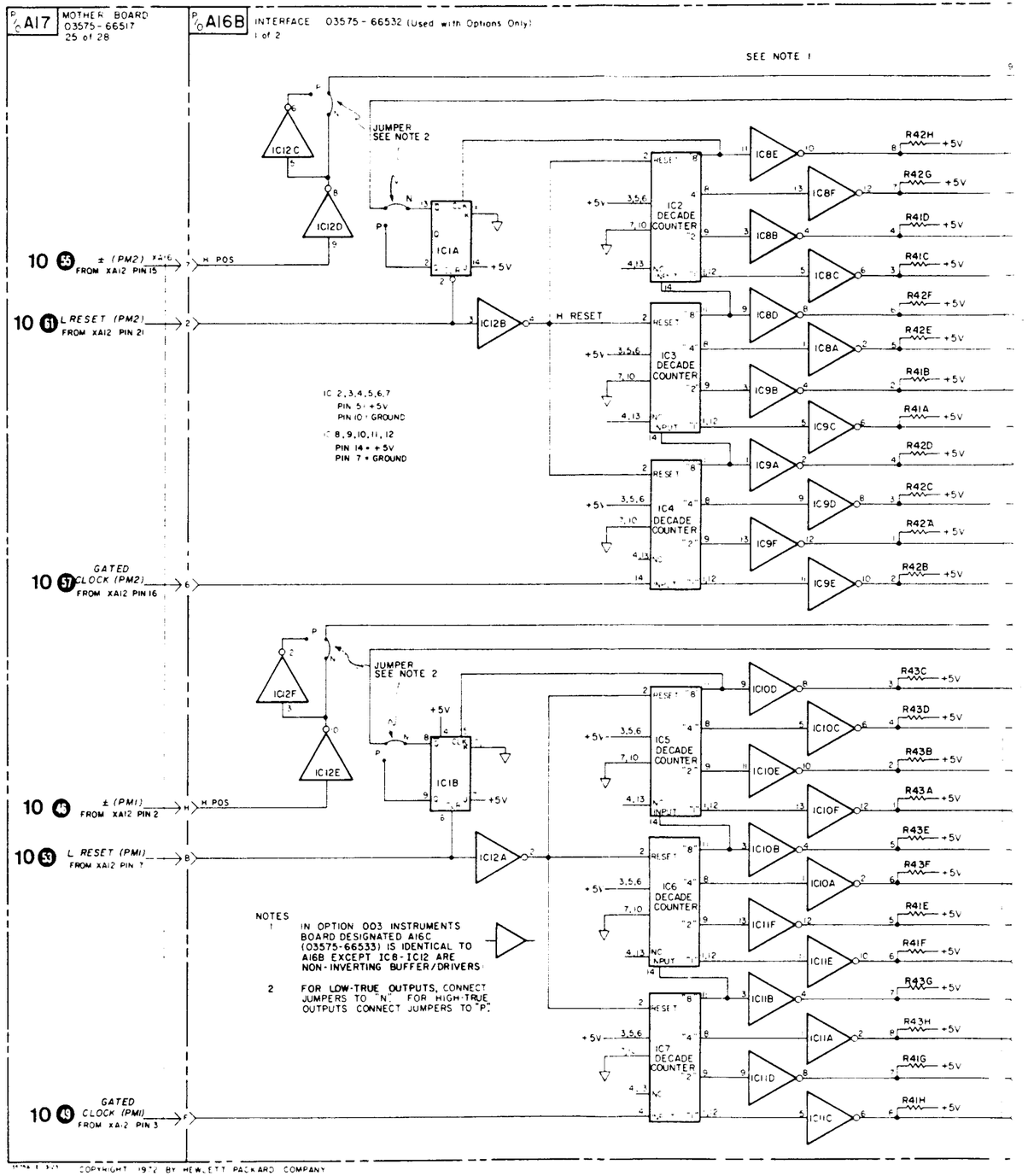

Figure 7-8. Panel Meter Connector (A12A) and Panel Meter (A20 Schematics and Component Location Diagrams.




A16B or A16C

*hp* Part No. 03575-66532 (B) OPT 002
66533 (C) OPT 003

Rev. A

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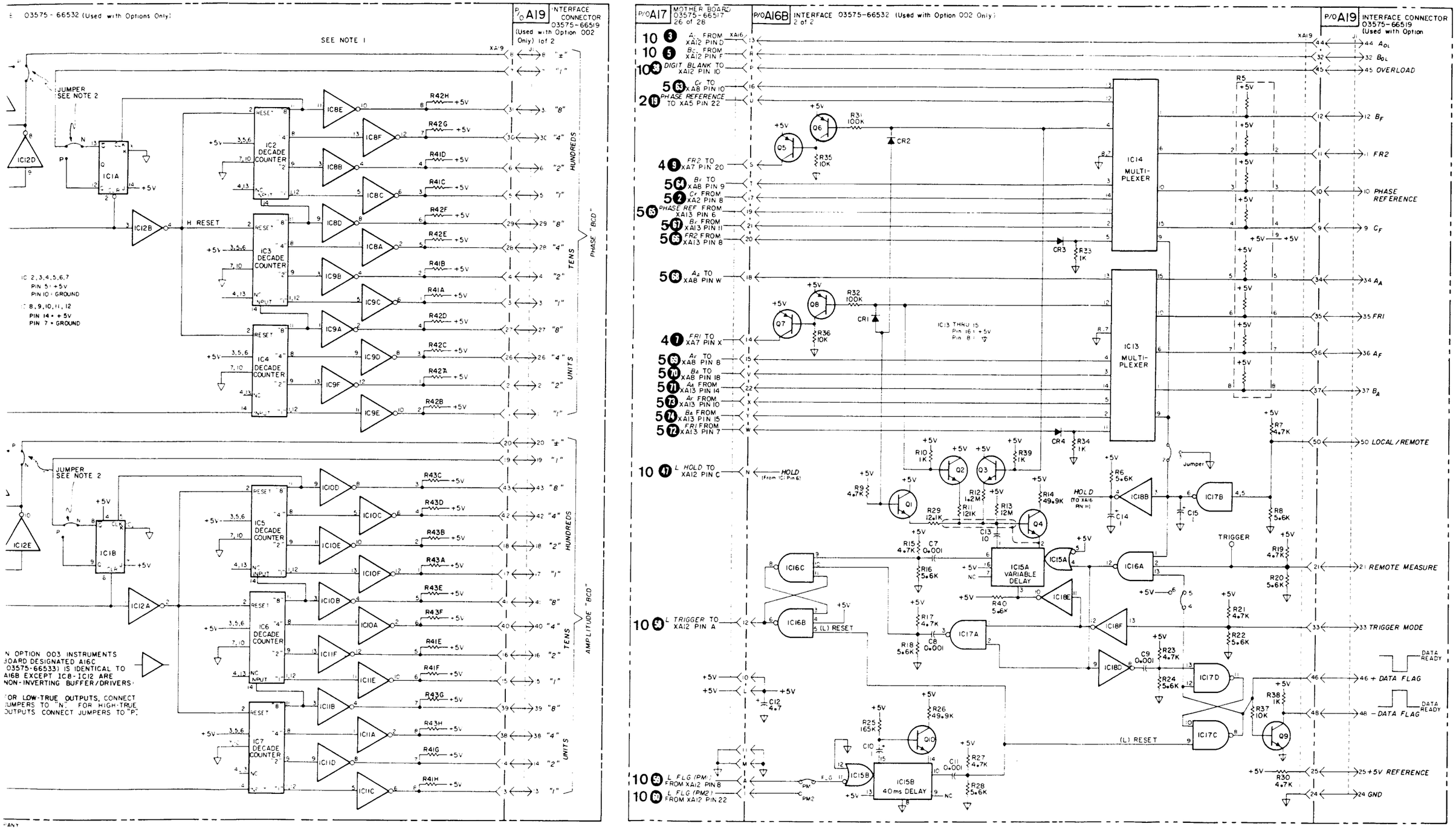
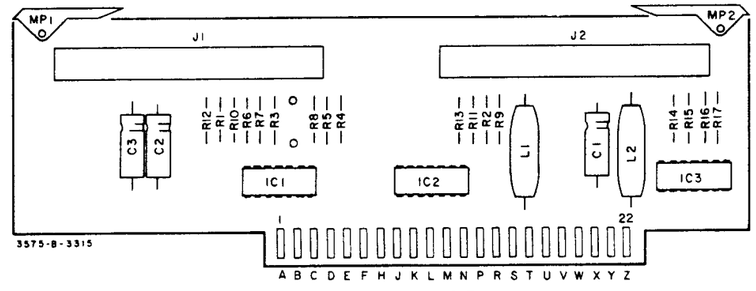



Figure 7-10. Interface Board A16B (Option 002) or A16C (Option 003) Schematic and Component Location Diagram.




A12B

*hp* Part No. 03575-66531

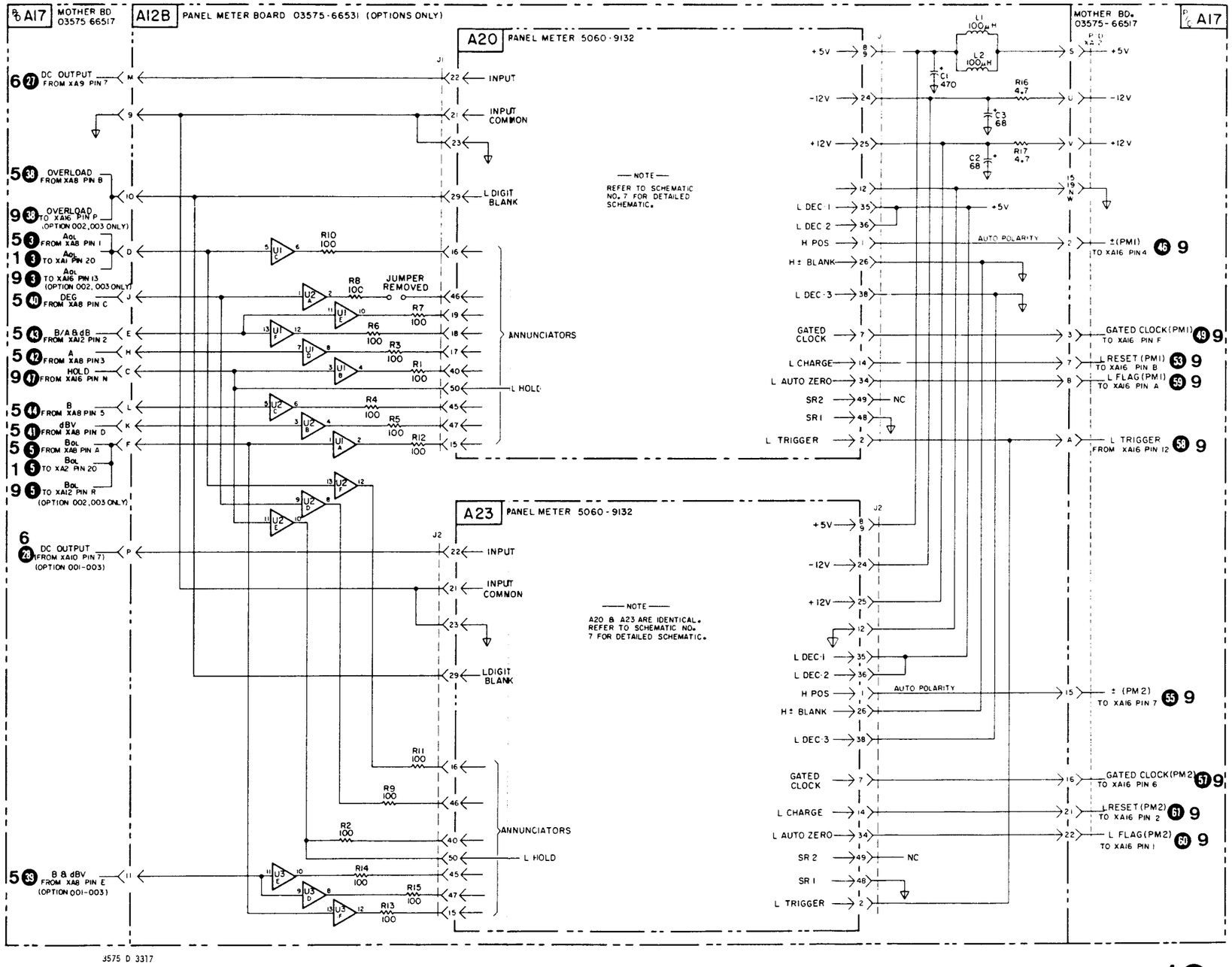





Figure 7-11. Panel Meter Connector (A12B) and Panel Meters (A20, A23) Schematics and Component Location Diagrams.

CHANGE NO. 6

Section VI Changes

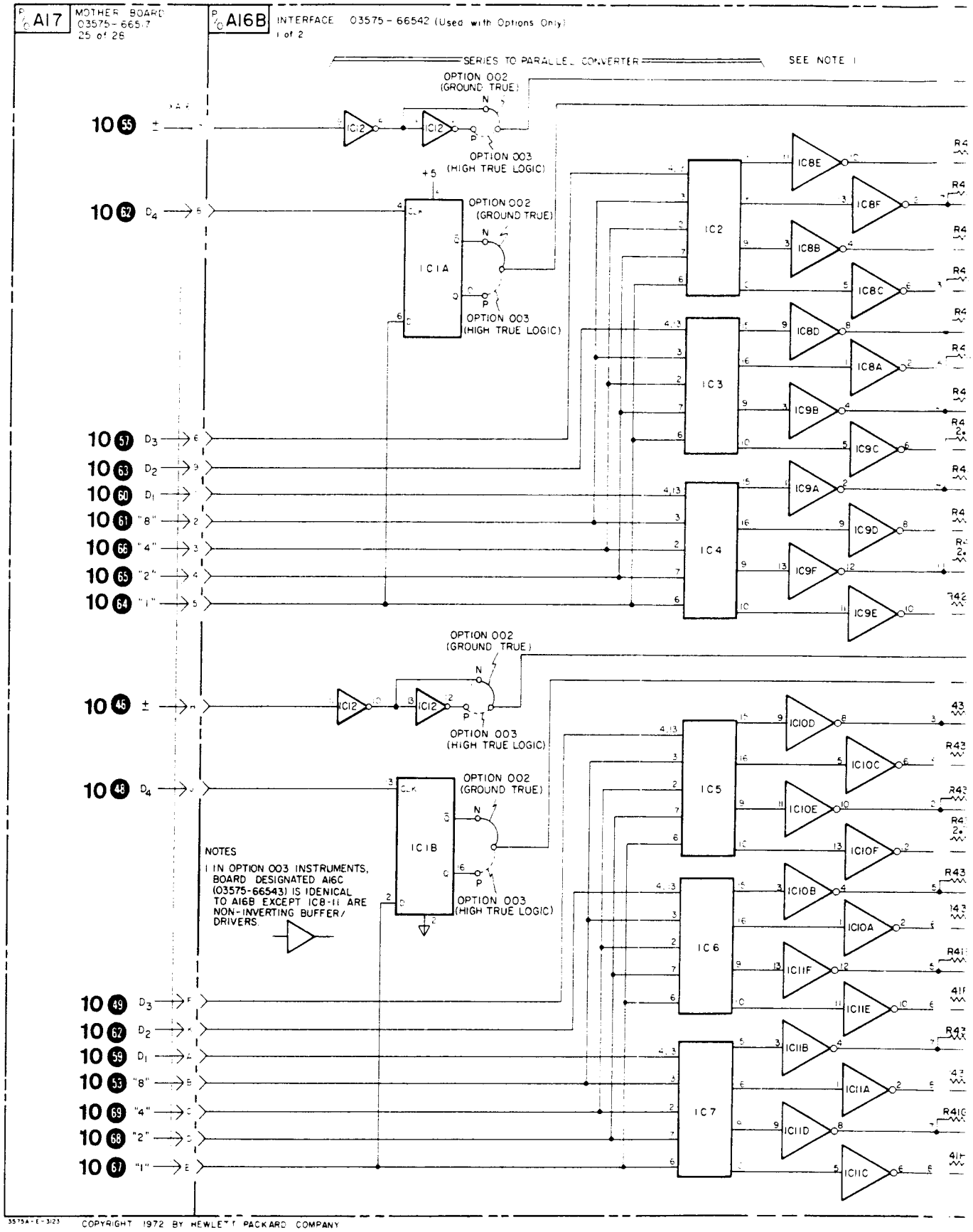
Change the A12B assembly part number to 03575-66541.
Change A12BC4-C11 to part number 0160-2964, C: fxd .01 μF 25 V.
Delete A12BU5 and U6.
Change the A16B assembly part number to 03575-66542.
Change A16BU1 - U7 to part number 1820-0876, TTL Latch 74L75N.
Change the A16C assembly part number to 03575-66543.
Change A16CU1 - U7 to part number 1820-0876, TTL Latch 74L75N.

Section VII Changes.

Replace Schematic Numbers 9 and 10 with the following Appendix C schematics.

CHANGE NO. 7:

For a standard instrument, delete the A12A component locator (03575-66550) and reference to this part number on the schematic. Replace with Schematic 10, A12A schematic and locator of Change No. 6.

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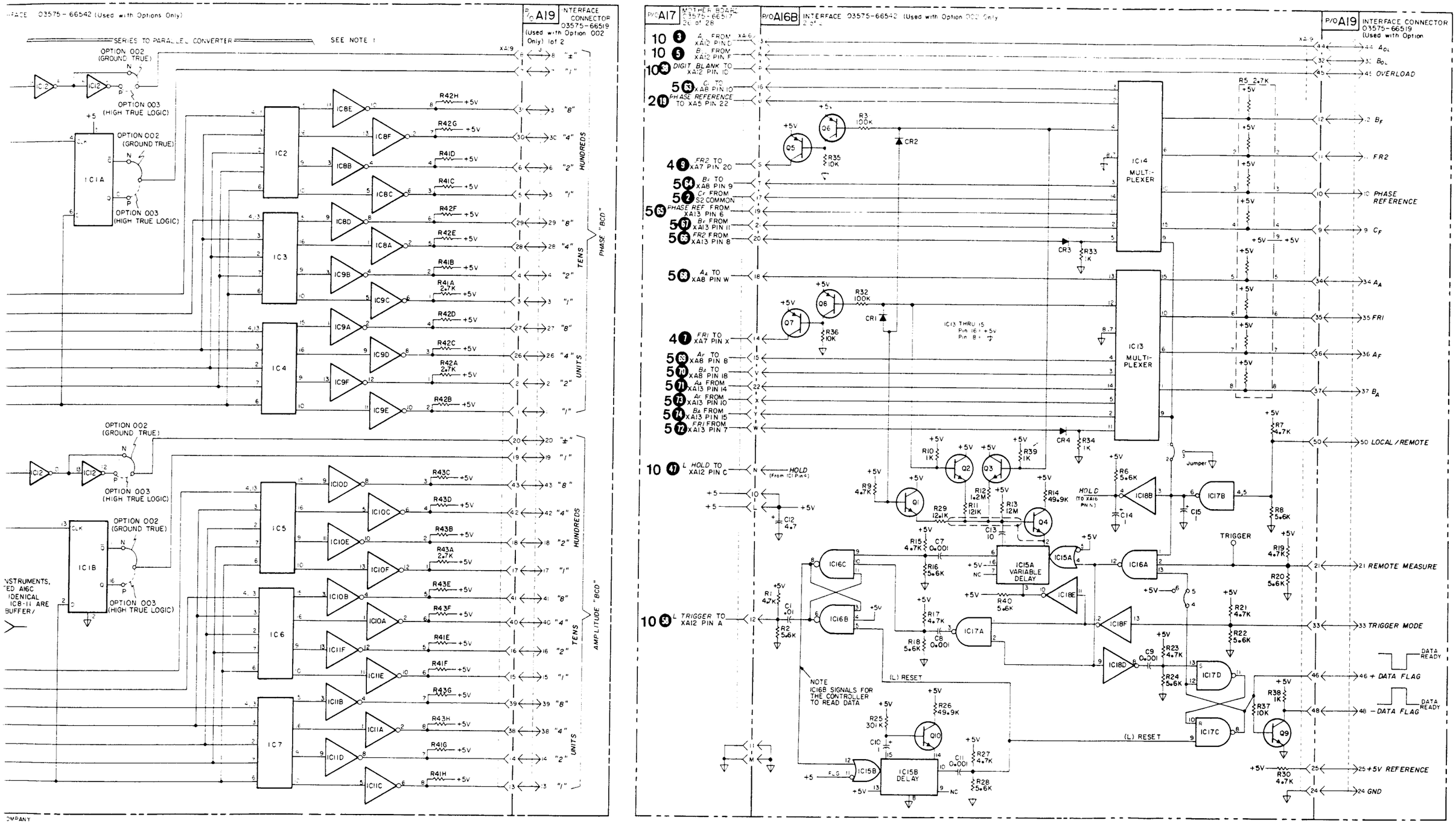
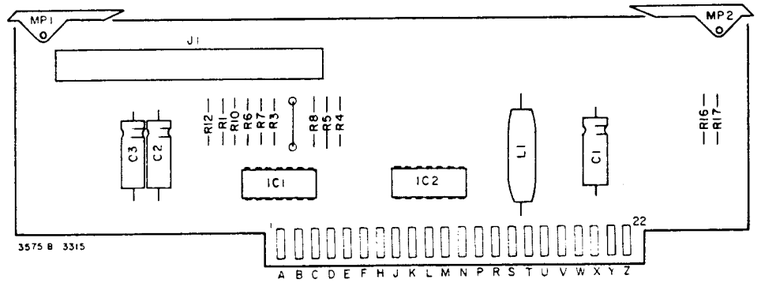






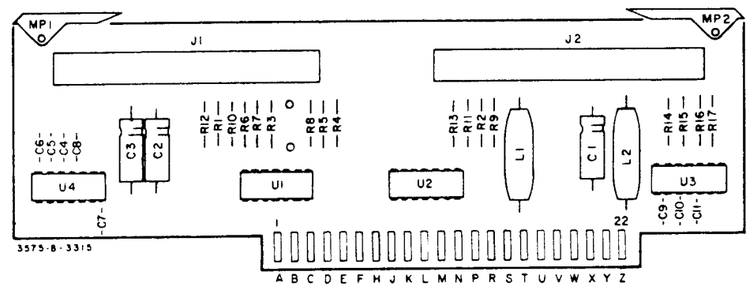
9

Figure 7-10. Interface Board A16B (Option 002) or A16C (Option 003) Schematic and Component Location Diagram.




A12A

*hp* Part No. 03575-66540




A12B

*hp* Part No. 03575-66541

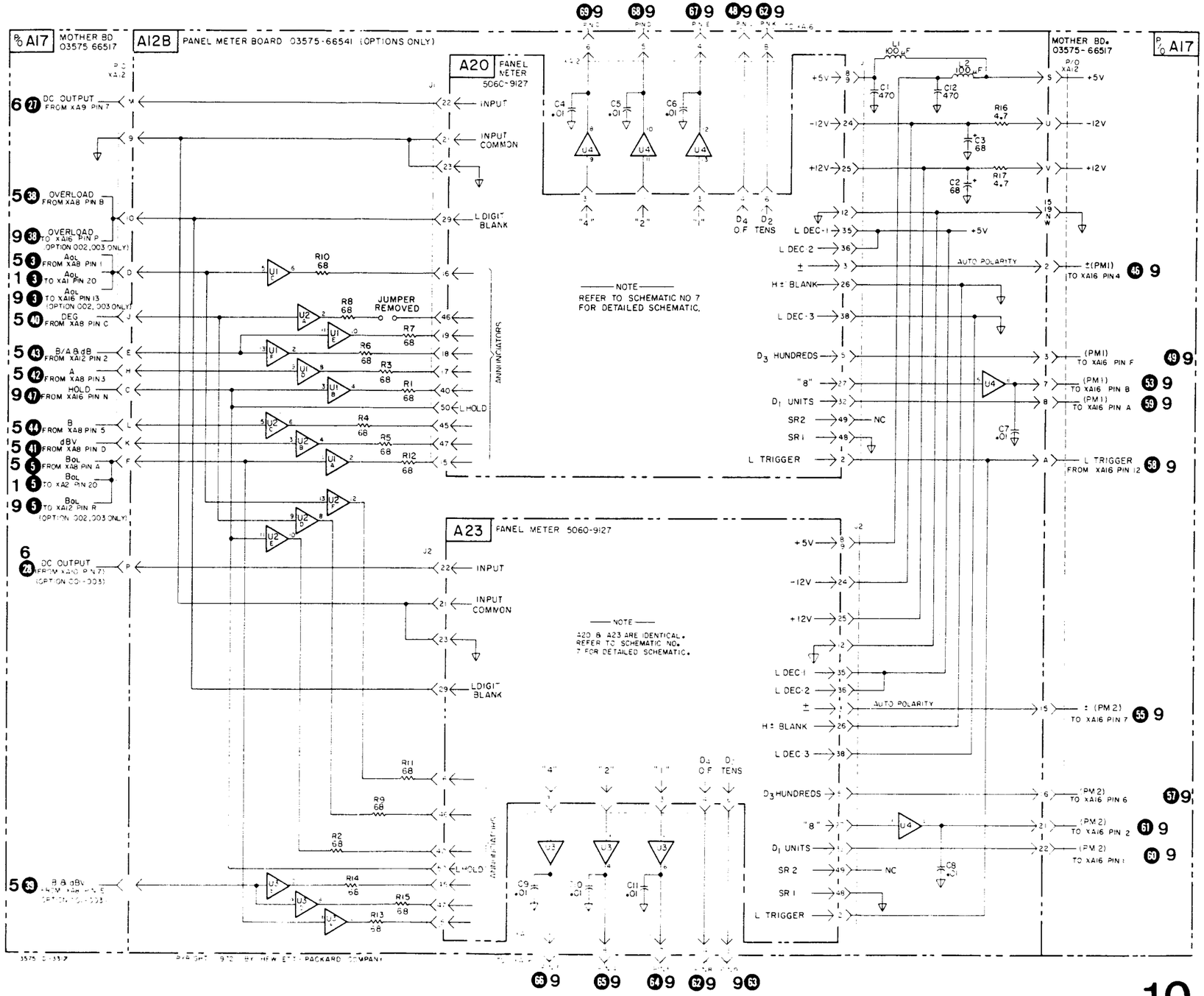



Figure 7-11. Panel Meter Connector (A12B) and Panel Meters (A20, A23) Schematics and Component Location Diagrams.

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